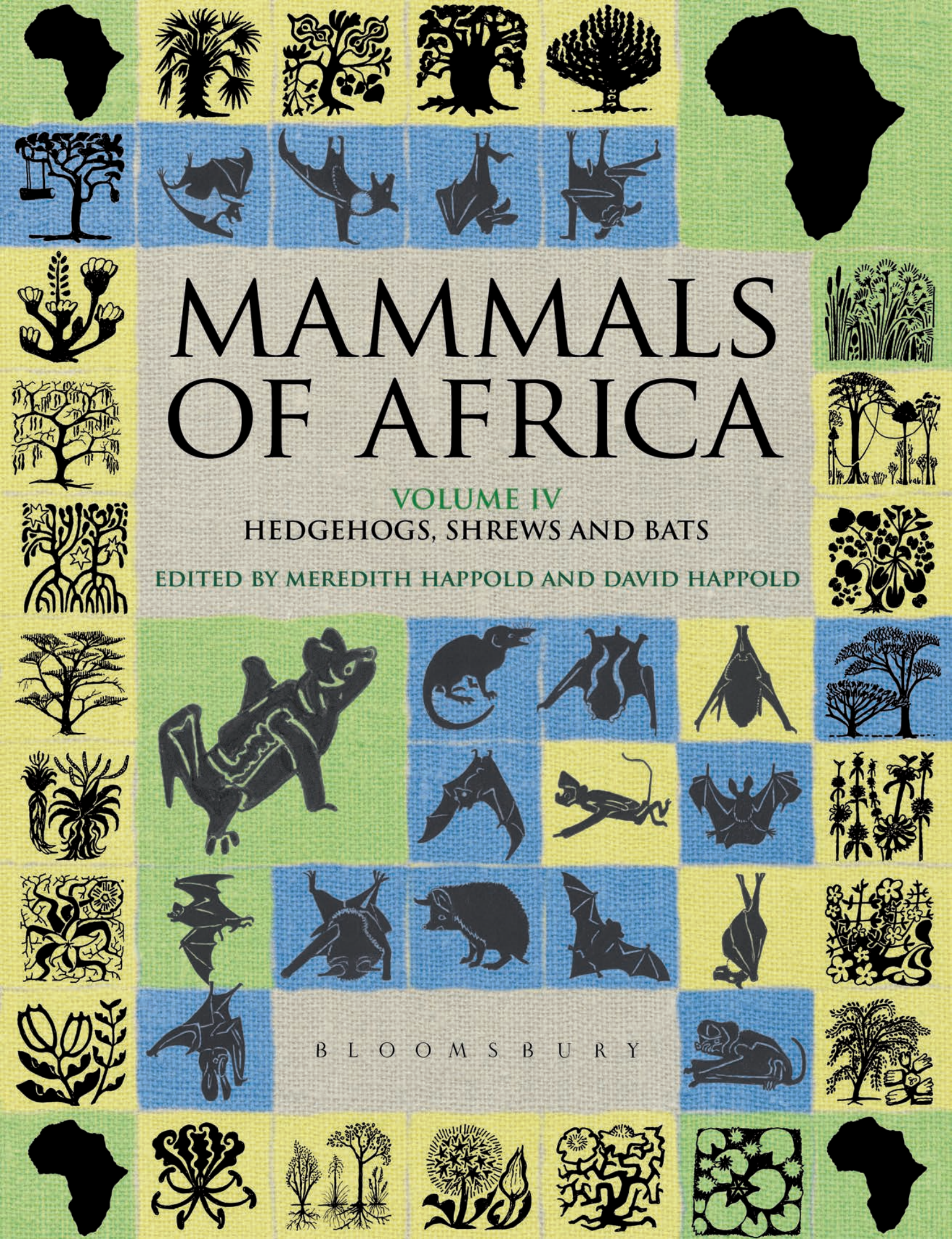


MAMMALS OF AFRICA

VOLUME IV

HEDGEHOGS, SHREWS AND BATS

EDITED BY MEREDITH HAPPOLD AND DAVID HAPPOLD

BLOOMSBURY

MAMMALS OF AFRICA

VOLUME IV

HEDGEHOGS, SHREWS AND BATS

Series Editors

Jonathan Kingdon

Department of Zoology, University of Oxford

David C. D. Happold

Research School of Biology, Australian National University

Thomas M. Butynski

Zoological Society of London / King KhalidWildlife Research Centre

Michael Hoffmann

International Union for Conservation of Nature – Species Survival Commission

Meredith Happold

Research School of Biology, Australian National University

Jan Kalina

Soita Nyiro Conservancy, Kenya

MAMMALS OF AFRICA

VOLUME IV

HEDGEHOGS, SHREWS AND BATS

EDITED BY MEREDITH HAPPOLD AND DAVID C. D. HAPPOLD

COLOUR AND PENCIL ILLUSTRATIONS BY JONATHAN KINGDON
PEN AND INK ILLUSTRATIONS BY MEREDITH HAPPOLD

BLOOMSBURY
LONDON • NEW DELHI • NEW YORK • SYDNEY

First published in 2013

Bloomsbury Publishing Plc, 50 Bedford Square, London WC1B 3DP
Bloomsbury USA, 175 Fifth Avenue, New York, NY 10010

www.bloomsbury.com
www.bloomsburyusa.com

Bloomsbury Publishing, London, New Delhi, New York and Sydney

A CIP catalogue record for this book is available from the British Library.
Library of Congress Cataloging-in-Publication Data has been applied for.

Commissioning editor: Nigel Redman
Design and project management: D & N Publishing, Baydon, Wiltshire

ISBN (print) 978-1-4081-2254-9
ISBN (epdf) 978-1-4081-8993-1

Printed in China by C&C Offset Printing Co., Ltd

This book is produced using paper that is made from wood grown in managed sustainable forests. It is natural, renewable and recyclable. The logging and manufacturing processes conform to the environmental regulation of the country of origin.

10 9 8 7 6 5 4 3 2 1

Recommended citations:

Series: Kingdon, J., Happold, D., Butynski, T., Hoffmann, M., Happold, M. & Kalina, J. (eds) 2013. *Mammals of Africa* (6 vols). Bloomsbury Publishing, London.

Volume IV: Happold, M. & Happold, D. C. D. (eds) 2013. *Mammals of Africa. Volume IV: Hedgehogs, Shrews and Bats*. Bloomsbury Publishing, London.

Chapter / species profile: e.g. Yalden, D. W. & Happold, M. 2013. *Otomops martiensseni* Large-eared Giant Mastiff Bat; pp 554–556 in Happold, M. & Happold, D. C. D. (eds) 2013. *Mammals of Africa: Volume IV*. Bloomsbury Publishing, London.

Donors and Patrons

T. R. B. Davenport, D. De Luca and the Wildlife Conservation Society, Tanzania

R. Dawkins

R. Farrand & L. Snook

R. Heyworth, S. Pullen and the Cotswold Wildlife Park

G. Ohrstrom

Viscount Ridley & M. Ridley

L. Scott and the Smithsonian UK Charitable Trust

M. & L. Ward

R. & M. Ward

This page intentionally left blank

Contents

Series Acknowledgements

Jonathan Kingdon, David Happold, Thomas Butynski,

Michael Hoffmann, Meredith Happold and Jan Kalina

The editors wish to record their thanks to all the authors who have contributed to *Mammals of Africa* for their expert work and for their patience over the very protracted period that these volumes have taken to materialize. We also thank the numerous reviewers who have read and commented on earlier drafts of this work.

We are also grateful for the generosity of our sponsoring patrons, whose names are recorded on our title pages, who have made the publication of these volumes possible.

Special thanks are due to Andy Richford, the Publishing Editor at Academic Press, who initiated and supported our work on *Mammals of Africa*, from its inception up to the point where Bloomsbury Publishing assumed responsibility, and to Nigel Redman (Head of Natural History at Bloomsbury), David and Namrita Price-Goodfellow at D & N Publishing, and the whole production team who have brought this work to fruition. We also acknowledge, with thanks, Elaine Leek who copy-edited every volume. We are grateful to Chuck Crumly, formerly of Academic Press and now the University of California Press, for being our active advocate during difficult times.

We have benefited from the knowledge and assistance of scholars and staff at numerous museums, universities and other institutions all over the world. More detailed and personal acknowledgements follow from the editors of each volume.

The editors are also grateful to the coordinating team of the Global Mammal Assessment, an initiative of the International Union for Conservation of Nature (IUCN), which organized a series of workshops to review the taxonomy and current distribution maps for many species of African mammals. These workshops were hosted by the Zoological Society of London, Disney's Animal Kingdom, the Owston's Palm Civet Conservation Programme, and the Wildlife Conservation Research Unit at the University of Oxford; additionally, IUCN conducted a review of the maps for the large mammals by the Specialist Groups of the Species Survival Commission. We owe a particular word of thanks to all the staff and personnel who made these workshops possible, and to the participants who attended and provided their time and expertise to this important initiative. We also thank IUCN for permission to use data from the *IUCN Red List of Threatened Species.*

ABOVE LEFT: Jan Kalina.
ABOVE: *From left to right:* Jonathan Kingdon, Thomas Butynski, Meredith Happold, David Happold and Andrew Richford.
LEFT: Jonathan Kingdon (*left*) and Michael Hoffmann.

Acknowledgements for Volume IV

Meredith Happold and D. C. D. Happold

We owe a great debt of gratitude to the many people who have helped and encouraged us with our research on African small mammals for nearly 50 years and hence have contributed enormously to this volume. When we were beginning our research, the following colleagues were marvellous sources of inspiration: Frank Ansell†, Fritz Dieterlen, John Edwards Hill†, Dieter Kock, Karl Koopman†, Erwin Kulzer, Waldo Meester†, Francis Petter†, Don Rosevear†, Hank Setzer† and Reay Smithers†. We also acknowledge the many collectors who, from the nineteenth century onwards, collected specimens, often in remote parts of Africa and often under appallingly difficult conditions, and sent them back to museums in Britain, Europe and North America where they still provide invaluable information. We are also extremely grateful to our colleagues (many of whom are authors of profiles in this volume) who have given so very generously of their time and knowledge to make this volume possible. [† Deceased]

This volume owes a great deal to the museums that house specimens of African small mammals. For many years, we have visited museums whenever the opportunity has occurred, and we are most grateful to the curators and their assistants who have helped during our visits: David Harrison, Paul Bates and Malcolm Pearch (Harrison Zoological Institute, Sevenoaks, England), Gabor Csorba (Hungarian Natural History Museum), Francis Petter† and Jacques Cuisin (Museum National d'Histoire Naturelle, Paris, France), Lydia Kigo (National Museum of Kenya, Nairobi, Kenya), Frederike Spitzenberger and Barbara Herzig (Naturhistorisches Museum, Vienna, Austria), Wim Wendelen (Royal Museum of Central Africa, Tervuren, Belgium), Judith Eger (Royal Ontario Museum, Toronto, Canada), Dieter Kock (Senkenberg Museum, Frankfurt, Germany), Fritz Dieterlen (Staatliches Museum für Naturkunde, Stuttgart, Germany), Teresa Kearney and Christian Chimimba (Transvaal Museum, Pretoria, South Africa) and Rainer Hutterer (Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany). We owe a special debt of gratitude to the Natural History Museum, London, England (formerly British Museum of Natural History), especially Gordon Corbet, John Edwards Hill†, Robert Hayman†, Paula Jenkins, Jean Ingles, Daphne Hills and Louise Tomsett who have allowed us (since 1964) to examine the collections and have assisted us in numerous ways. Particular thanks also are due to Michael and Mona Ensor and Sara Churchfield in London, the Ostermeyer and Schlöder families in Bonn, our friends in Corniche Verte, Brussels, and Mike and Anne-Marie Swift in Nairobi, who provided us with welcoming homes and sustenance after our busy days in museums.

We wish to thank the various universities, where one or both of us has been employed, for their support for our studies on African mammals: Australian National University, Canberra, Australia; University of Ibadan, Nigeria; University of Khartoum, Sudan; and University of Malawi, Zomba, Malawi. The Australian Research Grants Committee also provided funds for our more recent work in Malawi.

This volume would not have been possible without the contributions and invaluable collaboration from the authors themselves. Many authors had other commitments and found it extremely hard to find the time for writing profiles. Great credit is due to them for their dedication and perseverance, and for accepting that many of the sections (especially the descriptions) needed heavy editing to ensure that the profiles became uniform in terminology and content, compatible and comparable, and hence functional and unambiguous. Our thanks are also due to the many reviewers (listed here in alphabetical order) who reviewed profiles for this volume: Stéphane Aulganier, Paul Bates, Rod Baxter, Petr Benda, Nigel Bennett, Wim Bergmans, Gary Bronner, Charles Calisher, Gabor Csorba, J. F. Dahl, Jan Decher, Nico Dippenaar, Njikoha Ebigbo, Judith Eger, Jakob Fahr, Roger Fons, Jiří Gaisler, Norberto Giannini, Werner Haberl, Rainer Hutterer, David Jacobs, Jenny Jarvis, Teresa Kearney, Julian Kerbis Peterhans, Kazimierz Kowalski, Barbara Rzebik-Kowalska, Dieter Kock, Erwin Kulzer, Emile Lecompte, Anthony Maddock, Conrad Matthee, Françoise Poitevin, Nigel Reeve, Manuel Ruedi, Duane Schlitter, Nancy Simmons, Katja Soer, Sandy Sowler, Peter Taylor, Michel Thévenot, Erik Thorn, Don Thomas, Yves Tupinier, Victor Van Cakenberghe, Peter Vogel and Johan Watson.

We also acknowledge, with deep gratitude, all who have provided specialist knowledge and advice: in particular, Paul Bates, Wim Bergmans, Patrick Boland, Gary Bronner, Charles Calisher, Mike Carleton, Laurent Granjon, Colin Groves, David Harrison, Tony Hutson, Dieter Kock, Ernest Seamark, Nancy Simmons, Victor Van Cakenberghe and Marianne Volleth. We also thank Stéphane Aulagnier who provided the French names of bats, Jakob Fahr and Cornelia Rumpp who provided the German names of bats, and Anke Hoffman who provided many of the German names of other small mammals.

We are extremely grateful to the coordinating team of the Global Mammal Assessment, an initiative of the International Union for the Conservation of Nature (IUCN) and The Zoological Society of London who organized the workshops referred to in the Series Acknowledgements. We are also especially grateful to Zoe Cokeliss who digitized all the distribution maps of the small mammals.

Mammals of Africa: *An Introduction and Guide*

David Happold, Michael Hoffmann, Thomas Butynski and Jonathan Kingdon

Mammals of Africa is a series of six volumes that describes, in detail, every extant species of African land mammal that was recognized at the time the profiles were written (Table 1). This is the first time that such an extensive coverage has been attempted; all previous books and field guides have either been regional in coverage, or have described a selection of mammal species – usually the larger species. These volumes demonstrate the diversity of Africa's mammals, summarize what is known about the distribution, ecology, behaviour and conservation status of each species, and serve as a guide to identification.

Africa has changed greatly in recent decades because of increases in human populations, exploitation of natural resources, agricultural development and urban expansion. Throughout the continent, extensive areas of forest have been destroyed and much of the forest that remains is degraded and fragmented. Savanna habitats have been altered by felling of trees and development for agriculture. Many of the drier areas are threatened with desertification. As a result, the abundance and geographic ranges of many species of mammals have declined – some marginally, some catastrophically, some to extinction. Hence, it seems appropriate that our knowledge of each species is recorded now, on a pan-African basis, because the next few decades will see even more human-induced changes. How such changes will affect each mammalian species is uncertain, but this series of volumes will act as a baseline for assessing future change.

Table 1. The mammals of Africa.

Order	Number of families	Number of genera	Number of species
Hyracoidea	1	3	5
Proboscidea	1	1	2
Sirenia	2	2	2
Afrosoricida	2	11	24
Macroscelidea	1	4	15
Tubulidentata	1	1	1
Primates	4	25	93
Rodentia	15	98	395[a]
Lagomorpha	1	5	13
Erinaceomorpha	1	3	6
Soricomorpha	1	9	150
Chiroptera	9	49	224
Carnivora	9	38	83
Pholidota	1	3	4
Perissodactyla	2	3	6
Cetartiodactyla	6	41	93
16	**57**	**296**	**1116[b]**

[a] Including five introduced species. [b] Species profiles in *Mammals of Africa*.

The study of African mammals has taken several stages. During the era of European exploration and colonization, the scientific study of African mammals was largely descriptive. Specimens that were sent to museums were described and named. As more specimens became available, and from different parts of the Continent, there was increasing interest in distribution and abundance, and in the ecological and behavioural attributes of species and communities. At first, it was the largest and most easily observed species that were the focus of most studies but, as new methodologies and equipment became available, the smaller, seldom seen, secretive species became better known. Many species were studied because of their suspected role in diseases of humans and livestock, and because they were proven or potential 'pests' in agricultural systems. During the past decade or so, there has been greater emphasis on the karyotypic and molecular/genetic characters of species. These studies have produced a wealth of information, especially during the past 40 years or so. These volumes are not only a distillation of the huge literature that now exists on African mammals: they also contain much previously unpublished information.

There is a huge discrepancy among species in the amount of information available. Some species have been studied extensively for many years, especially the so-called 'game species', some species of primates and a few species that are widespread and/or easily observed. In contrast, other species are known only by one or a few specimens, and almost nothing is known about them. Likewise, some areas and countries have been well studied, while other areas and countries have been neglected. During the preparation of these volumes, the editors have often been surprised by the wealth of information about some species when little was anticipated, and by the paucity of information about others, some of which were assumed to be 'well known'. In addition to presenting information that is based on sound scientific evidence, the aims of these volumes are to point out where there are gaps in knowledge and to correct inaccurate information that has become embedded in the literature. For most taxa, the detail provided in the species profiles allows accurate identification.

Mammals of Africa comprises six volumes (Table 2). The volumes consist mainly of species profiles – each profile being a detailed

Table 2. The six volumes of *Mammals of Africa*.

Volume	Contents	Number of species	Editors
I	Introductory chapters. Afrotheria (Hyraxes, Elephants, Dugong, Manatee, Otter-shrews, Golden-moles, Sengis and Aardvark)	49	Jonathan Kingdon, David C. D. Happold, Michael Hoffmann, Thomas M. Butynski, Meredith Happold and Jan Kalina
II	Primates	93	Thomas M. Butynski, Jonathan Kingdon and Jan Kalina
III	Rodents, Hares and Rabbits	408	David C. D. Happold
IV	Hedgehogs, Shrews and Bats	380	Meredith Happold and David C. D. Happold
V	Carnivores, Pangolins, Equids and Rhinoceroses	93	Jonathan Kingdon and Michael Hoffmann
VI	Pigs, Hippopotamuses, Chevrotain, Giraffes, Deer and Bovids	93	Jonathan Kingdon and Michael Hoffmann

account of the species. They have been edited by six editors who distributed their work according to the orders with which they were most familiar. Each editor chose authors who had extensive knowledge of the species (or higher taxon) and, preferably, had experience with the species in the field. Each volume follows the same general format with respect to arrangement, subheadings and contents. Because *Mammals of Africa* has contributions from 356 authors (each with a different background and speciality), and because each volume was edited by one or more editors (each with a different perspective), it has not been possible or even desirable to ensure exact consistency throughout. Species profiles are not intended to be exhaustive literature reviews, partly for reasons of space. None the less, they are written and edited to be as comprehensive as possible, and to lead the reader to the most important literature for each species. Inevitably, not all information available could be accommodated for the better-known species, and so such profiles are a précis of available knowledge. Extensive references in the text alert the reader to more detailed information.

In addition to the species profiles, there are profiles for the higher taxa (genera, families, orders, etc.). Thus, there is a profile for each order, for each family within the order, for each genus within the family, and for each species within the genus. For some orders there are additional taxonomic levels, for example, tribes (e.g. in Bovidae), subgenera (e.g. in *Procolobus*) and species-groups, or 'super-species' (e.g. in *Cercopithecus*). The taxonomy used in these volumes mostly follows that presented in the third edition of *Mammal Species of the World: A Geographic and Taxonomic Reference* (2005), although authors have employed alternative taxonomies when there were good reasons for doing so. Volume I differs from the other volumes in that it contains a number of introductory chapters about Africa and its environment, and about African mammals in general.

The continent of Africa

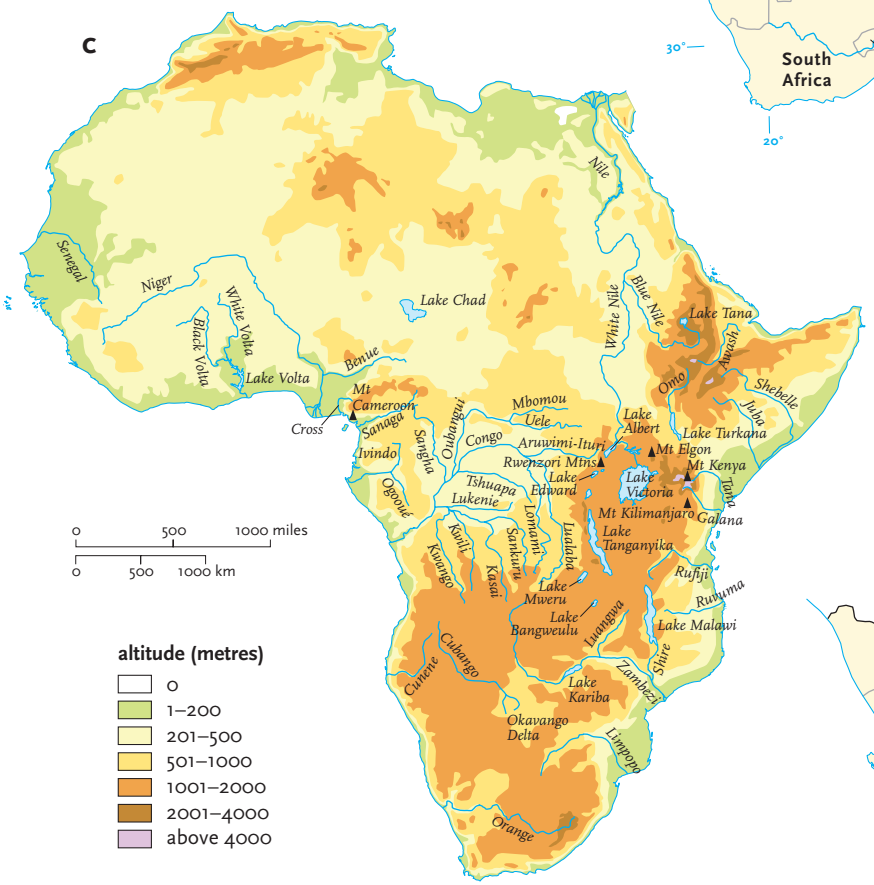
For the purposes of this work, 'Africa' is defined as the continent of Africa (bounded by the Mediterranean Sea, the Atlantic Ocean, the Indian Ocean, the Red Sea and the Suez Canal) and the islands on the continental shelf that, at some time in their history, have been joined to the African continent. The largest of the 'continental islands' are Zanzibar (Unguja), Mafia and Bioko (Fernando Po). All 'oceanic islands', e.g. São Tomé, Principe, Annobón (Pagulu), Madagascar, Comoros, Seychelles, Mauritius, Socotra, Canaries, Madeira and Cape Verde are excluded, with the exception of Pemba, which is included because of its close proximity (ca. 50 km) to the mainland.

The names of the countries of Africa are taken from the *Times Atlas* (2005). The Republic of Congo is referred to as 'Congo' and the Democratic Republic of Congo (formerly Zaire) as 'DR Congo'. Smaller geographical or administrative areas within countries are rarely referred to except for Provinces in South Africa, which are used extensively in the literature. Maps showing the political boundaries of Africa (Figure 1a), the Provinces of South Africa (Figure 1b) and the physical features of Africa with the major rivers and lakes (Figure 1c) are provided, as well as a list of the 47 countries together with their previous names that are used in the older literature on African mammals (Table 3).

Africa is the second largest continent in the world (after Asia), but it differs from other continents (except Australia and Antarctica) in being essentially an island. At various times in the past, Africa has been joined to other continents – a situation that has had a strong influence on the fauna and flora of the continent. Africa is a vast continent (29,000,000 km², 11,200,000 mi²) that straddles the Equator, with about two-thirds of its area in the northern hemisphere and one-third in the southern hemisphere. As a result, Africa has many varied climates (with seasons in each hemisphere being 6 months out of phase), many habitats (including deserts, savannas, woodlands, swamps, rivers, lakes, moist forests, monsoon forests, mountains and glaciers), and altitudes ranging from 155 m (509 ft) below sea level at L. Assal, Djibouti, in the Danakil (Afar) Depression, to 5895 m (19,341 ft) on Mt Kilimanjaro, Tanzania. Africa is comprised of 47 countries, some of which are very large (e.g. Sudan [2,506,000 km²; 967,000 mi²], Algeria (2,382,000 km², 920,000 mi²], and Democratic Republic of Congo [2,345,000 km², 905,000 mi²]), and others that are relatively small (e.g. Djibouti [23,200 km², 9,000 sq miles], Swaziland [17,400 km², 6,700 mi²] and The Gambia [11,300 km², 4,400 mi²]). The human population of each country also varies greatly, from about 346/km² in Rwanda to only about 2.5/km² in Namibia. With its great size and varied habitats, Africa supports a high biodiversity, including a large number of species of mammals. Likewise, most countries have a high diversity of mammals (especially when compared with temperate countries).

Africa may also be divided into biotic zones (Figure 2). A biotic zone (BZ) is defined as an area within which there is a similar environment (primarily rainfall and temperature) and vegetation, and which differs in these respects from other biotic zones. Thirteen biotic zones are recognized, two of which may be divided into smaller categories. The biotic zones exploited by each species of mammal are listed in each profile for several reasons. They indicate the environmental conditions in which the species lives and they provide data with which the geographic distribution can be explained

Figure 1. (a) Political map of Africa; (b) provinces of South Africa; (c) altitudes and major rivers of Africa.
South Sudan and Somaliland are not identified as separate countries in the text.



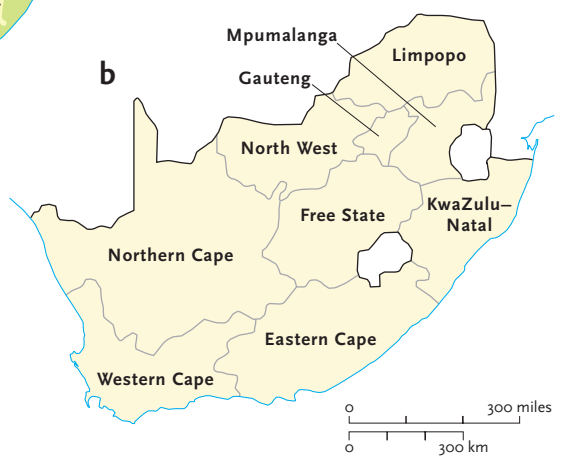


Table 3. The countries of Africa: names, areas and human population density.

Country name	Area (km^2) '000	Area ($miles^2$) '000	Human population '000 (2006)	People per km^2
Algeria	2,382	920.0	33,500	14.1
Angola (includes Cabinda)	1,247	481.0	15,800	12.7
Benin * [Dahomey]	113	43.0	8,700	77.0
Botswana [Bechuanaland]	582	225.0	1,800	3.1
Burkina Faso * [Upper Volta; Burkina]	274	106.0	13,600	49.6
Burundi [part of Ruanda-Urundi (= part of Belgian Congo)]	27.8	10.7	7,800	280.5
Cameroon [includes former French Cameroon, German Cameroon and part of Eastern Nigeria]	475	184.0	17,300	36.2
Central African Republic #	623	241.0	4,300	6.9
Chad [Tchad]	1,284	496.0	10,000	5.8
Congo [Republic of Congo]	342	132.0	3,700	10.8
Côte d'Ivoire * [Ivory Coast]	322	125.0	19,700	61.2
Democratic Republic of Congo [Belgian Congo; Congo (Kinshasha); Zaire]	2,345	905.0	62,700	26.7
Djibouti [French Somaliland]	23.2	9.0	800	34.5
Egypt	1,001	387.0	75,400	75.3
Equatorial Guinea # (includes Rio Muni [Spanish Guinea] and Bioko I. [Fernando Po])	28.1	10.8	500	17.8
Eritrea (formerly part of Ethiopia)	94	36.0	4,600	48.9
Ethiopia [Abyssinia]	1,128	436.0	74,800	66.3
Gabon #	268	103.0	1,400	5.2
The Gambia	11.3	4.4	1,500	132.7
Ghana [Gold Coast]	239	92.0	22,600	94.6
Guinea *	246	95.0	9,800	39.8
Guinea-Bissau [Portuguese Guinea]	36	13.9	1,400	38.9
Kenya	580	224.0	34,700	59.8
Lesotho [Basutoland]	30.4	11.7	1,800	59.2
Liberia	111	43.0	3,400	30.6
Libya	1,760	679.0	5,900	3.6
Malawi [Nyasaland]	118	46.0	12,800	108.5
Mali *	1,240	479.0	13,900	11.2
Mauritania *	1,030	412.0	3,200	3.1
Morocco [includes former Spanish Morocco and French Morocco]; (now also includes Western Sahara = former Spanish Sahara)	447	172.0	32,100	71.8
Mozambique [Portuguese East Africa]	802	309.0	19,900	24.8
Namibia [South-west Africa]	825	318.0	2,100	2.5
Niger *	1,267	489.0	14,400	11.3
Nigeria	924	357.0	134,500	145.6
Rwanda [part of Ruanda-Urundi (= part of Belgian Congo)]	26.3	10.2	9,100	346.0
Senegal *	197	76.0	11,900	60.4
Sierra Leone	71.7	27.7	5,700	79.5
Somalia ¥ [British Somaliland and Italian Somaliland; Somali Republic]	638	246.0	8,900	13.9
South Africa	1,220	471.0	47,300	38.7
Sudan § [Anglo-Egyptian Sudan]	2,506	967.0	41,200	16.4
Swaziland	17.4	6.7	1,100	63.2
Tanzania [German East Africa; Tanganyika] (now includes Zanzibar I., Mafia I. and Pemba I.)	945	365.0	37,900	40.1
Togo [Togoland]	56.8	21.9	6,300	110.9
Tunisia	164	63.0	10,100	61.6
Uganda	236	91.0	27,700	117.4
Zambia [Northern Rhodesia]	753	291.0	11,900	15.8
Zimbabwe [Southern Rhodesia]	391	151.0	13,100	33.5
Totals/mean density	**29,448**	**11,383**	**902,600**	**56.8**

Former names are listed in chronological order in square brackets, with the oldest name listed first. Obsolete names are listed because much of the older literature refers to past colonial entities. * = formerly part of French West Africa. # = formerly part of French Equatorial Africa. § At the time of going to press, the country of Sudan had been divided into two: the Republic of Sudan in the north, and the Republic of South Sudan in the south. ¥ The former British Somaliland is now a self-declared state under the name of the Republic of Somaliland, but remains internationally unrecognized.

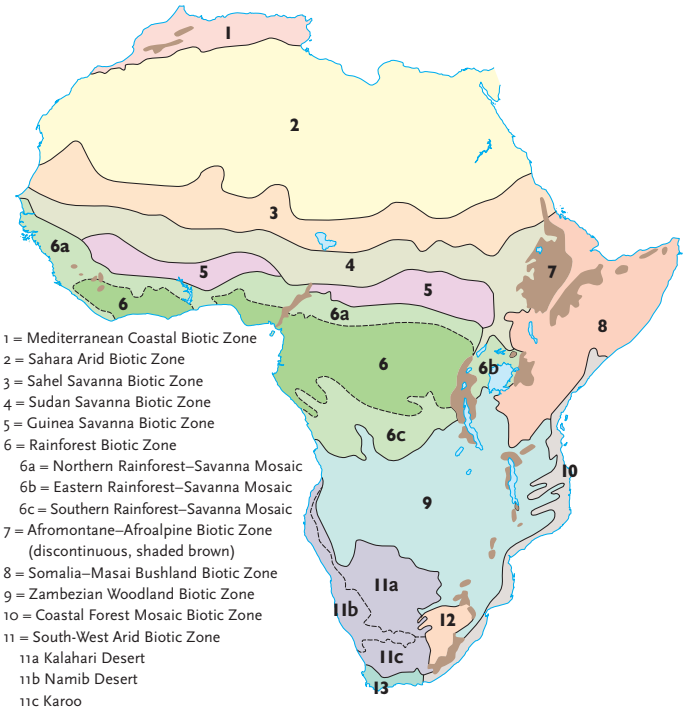


Figure 2. The biotic zones of Africa.

and predicted. Furthermore, the number of biotic zones exploited by a species indicates its level of habitat tolerance and the extent to which it is vulnerable to loss of a particular type of habitat. The Rainforest Biotic Zone (Figure 3) and the South-West Arid Biotic Zone are divided into regions and subregions that reflect the different biogeographical distributions of species within the zone, each region/subregion having a community of mammals and other animals that is different to any other. Details of the biotic zones of Africa, and the regions and subregions of the Rainforest Biotic Zone, are given in Volume I of *Mammals of Africa*.

The hedgehogs, shrews and bats of Africa

This volume is devoted to the orders Erinaceomorpha (hedgehogs), Soricomorpha (shrews) and Chiroptera (bats). These orders comprise 380 species (i.e. about 34% of all African mammals). Two of the orders contain many species – Soricomorpha (150 species) and Chiroptera (224 species) – and are the second and third most speciose orders after the Rodentia (395 species) (see Table 1). The seven orders that are considered to be the 'small mammals of Africa' (orders Afrosoricida and Macroscelidea [Volume I], Rodentia and Lagomorpha [Volume III], and Erinaceomorpha, Soricomorpha and Chiroptera [this volume]) collectively comprise 74.1% (827 of 1116) of all African mammalian species. Many species in the orders described in this volume have not been studied in detail because of their rarity and small geographic ranges; however, there is considerable knowledge about many of the species of bats.

There are two editors for this volume: Meredith Happold (Chiroptera; 224 species) and David C. D. Happold (Erinaceomorpha and Soricomorpha; 156 species).

The profiles for Volume IV were submitted to the editors between 2001 and 2005. It has not been possible to revise profiles since then; however, notes have sometimes been added to draw attention to important changes in taxonomy and distribution, the IUCN Categories of threat in the conservation sections have been updated, and citations of papers previously given as 'in press' have been completed. An Appendix has been added listing new taxa described during the period 2005–2010.

Species profiles

Information about each species is given under a series of subheadings. The amount of information under each of these subheadings varies greatly between species; where no information is available, this is recorded as 'No information available' or words to this effect. The sequence of subheadings is as follows:

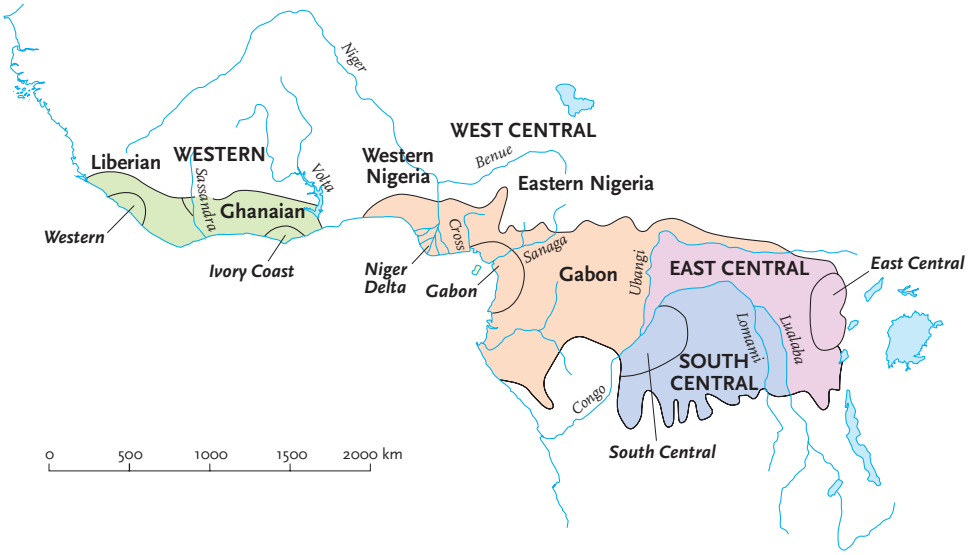


Figure 3. The Rainforest Biotic Zone showing the regions, subregions and refugia. Regions are indicated in capital letters and colours: Western region – green; West Central region – brown; East Central region – purple; South Central region – blue. Subregions are indicated in lower case letters. Refugia are indicated in lower case italics and yellow (after Happold 1996 and references therein; see also Happold & Lock, Volume I, *Mammals of Africa*).

Scientific name (genus and species) The currently accepted name of the species.

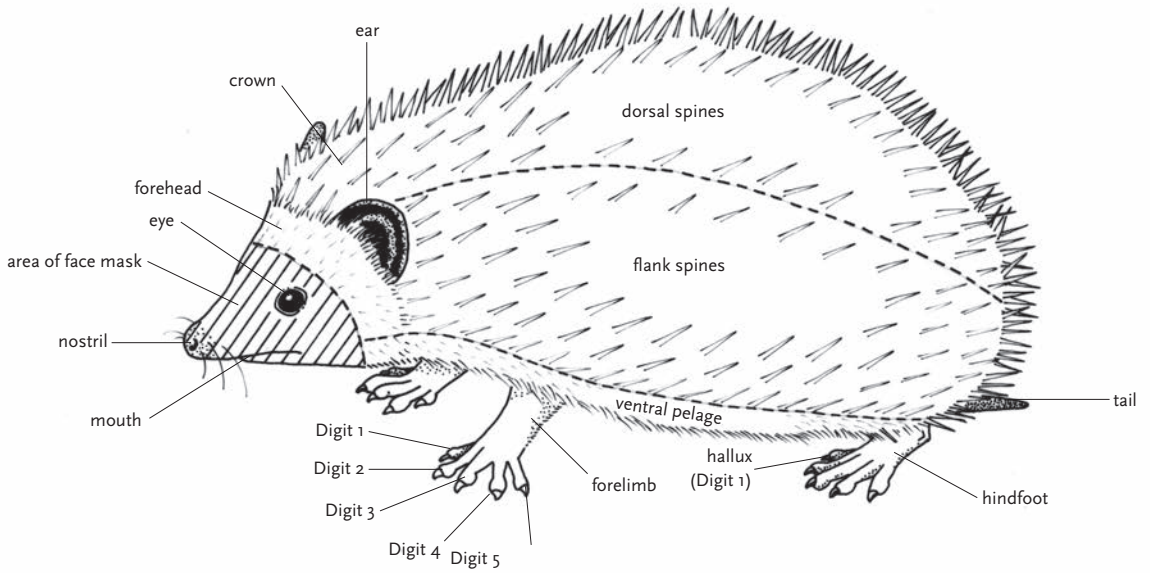
Vernacular names English, French and German names are given, as available. The first given English name is the preferred vernacular name for the species; alternative names are given in parentheses for some species. Wilson & Cole (2000) list proposed vernacular names for all the world's mammals; most of these names were also given in the third edition of *Mammal Species of the World* (Wilson & Reeder 2005). Although these works have been consulted, the names used have not always been adopted in *Mammals of Africa*. For the names of bats, there was collaboration between the authors of profiles, other bat specialists and Nancy Simmons (Simmons 2005): consequently the bat names, with very few exceptions, are the same in both publications. French names were either provided by Stéphane Aulagnier (bats), other profile authors, or taken from Gunther (2002). Most of the German names were provided by Jakob Fahr and Cornelia Rumpp (bats) and by Anke Hoffman (other taxa).

Scientific Citation This provides the full scientific name of the species, i.e. genus name, species name, authority name and date of authority. Parentheses around the authority's name and date indicate that the species was originally named in a different genus to the one it is placed in now. The scientific name is followed by the publication where the species was described, and the type locality (i.e. where the holotype [or type series] was obtained). Most of this information is taken from Wilson & Reeder (2005).

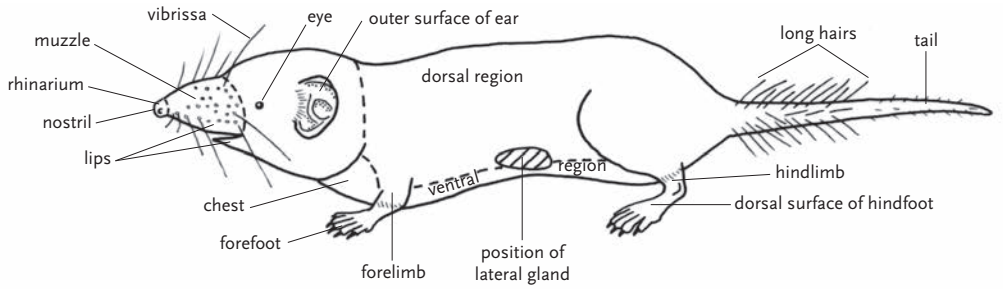
Taxonomy This section contains information about previous scientific names of the species, and problems and controversies (if any) associated with its nomenclature and relationships with other species. Major synonyms are listed (without the taxonomic authority unless essential for clarity), and the number of subspecies (usually only in Africa) is given: most of this information is from Wilson & Reeder (2005). The chromosome number is given if available, and in some cases this is followed by other information relevant to the chromosomes. In late 2006, a revised edition of the *Atlas of Mammalian Chromosomes* was published (O'Brien *et al.* 2006), but it has not been possible to incorporate the findings of that important work here.

Description This section, together with the illustrations and relevant tables, includes sufficient information to identify the species as well as describing characters that are relevant to the habits and life-style of the species. The section begins with a brief overall description of the species, including an indication of size. (For the bats, the first sentence lists the most useful diagnostic characters of the species, ending with those that distinguish it from its most similar species.) This is followed by a more detailed description of the external characters and skulls (including the diagnostic characters); the information given covers all subspecies (if any). It was not possible – or desirable – to describe the same suite of characters for every species. Instead, an appropriate selection was made for each family and/or genus, and therefore the same suite of characters is described for all members of the relevant taxon. Consequently the descriptions of related species are comparable and compatible. The table-keys (referred to as tables in the text) function as keys to the species, and should be read from the left column to the right column, which gives the name of the species thereby identified. The number and arrangement of nipples in adult females (for taxa other than bats) is noted wherever this feature varies between the taxa being discussed (see Glossary). The tables allow easy comparison between taxa within a genus or family.

Geographic Variation Variation within the species may be clinal (without subspecies) or subspecific. If the variation is clinal, there is a description of the character(s) that alters clinally across the geographic range of the species. If the variation is subspecific, each subspecies is listed together with its geographic range and the characters that distinguish it from the other subspecies.



External characters of a hypothetical hedgehog.



External characters of a hypothetical shrew.

Similar Species A list of similar species is given together with the diagnostic characters and/or measurements most useful to distinguish that particular species from the profiled species. If a character of a similar species is described as being 'larger' or 'smaller' than that of the profiled species, there is no known overlap in the ranges of measurements of this character. In contrast, if the ranges overlap but the means are different, a character is said to be 'larger on average' or 'smaller on average'. For the Order Chiroptera, similar species are considered to be those that share a specified combination of characters, whether or not they live sympatrically. For other orders, with some exceptions, the lists of similar species are restricted to those that are sympatric or parapatric with the profiled species; this section is omitted for the genus *Crocidura* because of the very large number of species (but see Table 8).

Distribution The first sentence is often 'Endemic to Africa' indicating that the species is found (in the wild) only in Africa. Alternatively, the section begins with the distribution in Africa, and the extralimital distribution is given at the end of the section. The Biotic Zone (or Zones) in which the species has been recorded are listed because this information indicates the sorts of environments exploited by that species, and the extent to which it is likely to be threatened by habitat change. Also, it is the basis for predictions of its distribution outside the currently known limits. Next, the distribution in African countries, or parts of countries, is described, and altitudinal ranges may be given. As a general rule, descriptions of the ranges of species with very restricted distributions are more precise in terms of information given (including, for example, geographic coordinates) than for more widespread species, where a more generalized statement is adequate. A distribution map (see below) augments the information given here.

Habitat This section provides a description of the habitat, or range of habitats, where the species lives. Details of plant communities, plant species, vegetation structure, soil type and/or structure, and water availability, etc. (if available) may be recorded. Other information may include average annual rainfall, altitudinal limits and seasonal variation in habitat characteristics.

Abundance This section attempts to indicate the comparative abundance of the species. For many species, quantitative data are unavailable but the species can be assessed as 'abundant', 'common', 'rare', 'rarely seen but often heard', 'rarely collected' etc. For some species, abundance is indicated by quantitative estimates of density (e.g. number/ha or number/km^2), or relative abundance within the community (e.g. 'comprised 40% of small mammals captured', 'the second most numerous species captured'). For the better-known or rare species, actual numbers of individuals for the species may be given. Other information may include seasonal changes in density, frequency of observations, or the relative abundance of specimens in collections.

Adaptations This section describes morphological, physiological and behavioural characteristics, which show how the species uniquely interacts with its environment, with conspecifics, and with other animals. This section may also describe species-specific adaptations for locomotion, burrowing, mechanisms for orientation, production of sound, sensory mechanisms and activity patterns. It may also include descriptions of domiciles and population movements (such as migration). In some instances, comparison with related or convergent species allows the unique adaptations of the species under discussion to be detailed or emphasized.

Foraging and Food The first sentence briefly describes the diet of the species (e.g. insectivorous, carnivorous, granivorous, etc.). This may be followed by the methods of collecting food (foraging), size of home-range and daily distance moved, and descriptions of feeding behaviour. The diet, if well-known, is then described in one or more of the following ways: a list of the taxa of animals or plants consumed, a quantitative measure based on direct observations, or by a qualitative or quantitative analysis of the stomach contents or faeces.

Social and Reproductive Behaviour Topics in this section may include social organization (e.g. solitary, social or colonial), group size and composition, agonistic and amicable behaviour, territoriality and home-range (including quantitative data), courtship and mating, parental behaviour and parent–young interactions, cooperative breeding and social vocalizations.

Reproduction and Population Structure If data are available, this section describes the reproductive strategy of the species, this being determined by the litter-size and the timing of reproductive events (i.e. the reproductive chronology). Reproductive chronologies cover the times of year when spermatogenesis, ovulation, copulation, gestation, parturition and lactation occur, and consequently this indicates the duration of pregnancy and lactation, and the number of pregnancies each female may have in one year. Reproductive chronologies give data for both individuals and local populations. Special adaptations such as reproductive delays (e.g. delayed implantation) and postpartum oestrus are mentioned, and

the timing of reproductive events in relation to climatic seasons, availability of food and other relevant events are discussed. This section may also include birth-weights and sizes of young, growth-rates, age at weaning and sexual maturity, and longevity. Finally, if data are available, population structure is discussed. This includes sex ratios, adult/young ratios, the abundance of different cohorts in the population at different times of the year, and mortality rates. In general, information on reproduction is much better known for bats than for other species described in this volume.

Predators, Parasites and Diseases The known predators, known parasites (usually ectoparasites only) and some diseases are listed. Additional information is given if the species is a host to diseases that affect humans and domestic stock, and if it is utilized as food for humans ('bushmeat').

Remarks This subheading subsumes five of the above subheadings (Adaptations, Foraging and Food, Social and Reproductive Behaviour, Reproduction and Population Structure, and Predators, Parasites and Diseases) in those instances where there is little or no information available.

Conservation The conservation status of the species (i.e. its IUCN Category) is taken from the 'Red List of Threatened Species' prepared by the International Union for Conservation of Nature (IUCN). The IUCN Red List Categories follow the definitions given in the *IUCN Red List Categories and Criteria Version 3.1* (see www.iucnredlist.org) and are listed in Table 4. For those species classified as threatened (i.e. 'Vulnerable', 'Endangered' and 'Critically Endangered'), readers may obtain detailed reasons (the criteria) for the classification on the IUCN Red List website. The status of some species has been changed in recent years because of improved knowledge, changes in taxonomy, or the impact of threatening processes or conservation action; detailed reasons for the present status, and past status, are given on the IUCN Red List website. If a species is listed on an Appendix I or Appendix II under CITES (Convention on International Trade in Endangered Species; www.cites.org), this is also indicated. For some species, additional information is provided, such as presence in protected areas, major threats, and current or recommended conservation measures.

Measurements A series of morphological measurements is provided. For each species in a particular order there is a standard set of measurements. The abbreviation (and definition) for each measurement are given in the Glossary. A measurement is cited as the mean value (with minimum value to maximum value in parentheses) and sample size. For some, the standard deviation (mean ± 1 S.D.) is given instead of, or in addition to, the range. For most measurements, data for males and females are combined but where there is sexual dimorphism, measurements for males and females are given separately. Where possible, the localities of the measured specimens and the source of the data are provided. Sources are either cited publications, or specimens in museums, or unpublished information from the authors or others. The acronyms for museums where specimens were examined and measured are given in Table 5. Most museum records have been provided by the author of the profile; others – when an author did not have the measurements or did not have the opportunity to visit museums – were provided by the editors.

Key References A select list of references provides more information on the species. Each reference is given in full in the Bibliography.

Table 4. IUCN Red List Categories (from IUCN – International Union for Conservation of Nature).

Category	Description
Extinct (EX)	A taxon is **Extinct** when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life-cycles and life form.
Extinct in the Wild (EW)	A taxon is **Extinct in the Wild** when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life-cycle and life form.
Critically Endangered (CR)	A taxon is **Critically Endangered** when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	A taxon is **Endangered** when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	A taxon is **Vulnerable** when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	A taxon is **Near Threatened** when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for (or is likely to qualify for) a threatened category in the near future.
Least Concern (LC)	A taxon is **Least Concern** when it has been evaluated against the criteria and does not qualify for the Critically Endangered, Endangered, Vulnerable or Near Threatened categories. Widespread and abundant taxa are included in this category.
Data Deficient (DD)	A taxon is **Data Deficient** when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. Data Deficient is not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that a threatened classification is appropriate.
Not Evaluated (NE)	A taxon is **Not Evaluated** when it has not yet been evaluated against the criteria.

Table 5. Acronyms for museum and private collections.

Acronym	Museum name
AM	Amatole Museum, King William's Town, South Africa. [formerly Kaffrarian Museum].
AMNH	American Museum of Natural History, New York, USA.
BMNH	Natural History Museum, London, UK [formerly British Museum (Natural History)].
CAS	California Academy of Sciences, San Francisco, USA.
CM	Carnegie Museum of Natural History, Pittsburgh, USA.
CZL	Centro de Zoologia, Lisboa, Portugal.
DM	Durban Natural Science Museum, Durban, South Africa.
EBD	Estación Biológica de Doñana, Seville, Spain.
FC	Fahr Collection, Ulm, Germany (private collection).
FMNH	Field Museum of Natural History, Chicago, USA.
HC	Happold Collection, Canberra, Australia (private collection).
HNHM	Hungarian Natural History Museum, Budapest, Hungary.
HZM	Harrison Zoological Museum, Sevenoaks, Kent, UK.
ICN	Instituto da Conservação da Natureza, Lisboa, Portugal.
IICT/CZ	Instituto de Investigação Científica Tropical, Centro de Zoologia, Lisboa, Portugal.
IRSN	Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium.
KU	Kansas Museum of Natural History, Lawrence, USA.
LACM	Los Angeles County Museum, Los Angeles, USA.
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, USA.
MHNC	Musée d'Histoire Naturelle, La Chaux-de-Fonds, Switzerland.
MHNG	Muséum d'Histoire Naturelle, Genève, Switzerland.
MHNS	Musée d'Histoire Naturelle, Strasbourg, France.
MMB	Museums of Malawi, Blantyre, Malawi.
MNHN	Muséum National d'Histoire Naturelle, Paris, France.
MSNM	Museo Civico di Storia Naturale di Milano, Milan, Italy.
MUMZ	Makerere University, Museum of Zoology, Kampala, Uganda.
MZUF	Museo Zoologico 'La Specola', Università di Firenze, Italy.
MZUT	Museo di Zoologia, Università di Torino, Italy.
NAU	Northern Arizona University Museum of Vertebrates, Flagstaff, Arizona, USA.
NHMB	Naturhistorisches Museum, Berlin, Germany.
NMB	National Museum (Bloemfontein), South Africa.
NMBE	Naturhistorisches Museum, Bern, Switzerland.
NMK	National Museums of Kenya, Nairobi, Kenya.
NMP	Natal Mueum, Pietermartizburg, South Africa.
NMW	Naturhistorisches Museum, Wien (Vienna), Austria.
NMZB	Natural History Museum of Zimbabwe, Bulawayo, Zimbabwe.
NRM	Naturhistoriska Riksmuseet, Stockholm, Sweden.
OSU	Oklahoma State University, Stillwater, USA.
RMCA	Royal Museum for Central Africa, Tervuren, Belgium.
RMNH	Nationaal Natuurhistorisch Museum, Leiden, the Netherlands. (formerly Rijksmuseum Natuurlijke Historie)
ROM	Royal Ontario Museum, Toronto, Canada.
SAM	South African Museum, Cape Town, South Africa.
SBPU1	Station Biologique de Paimpont, Université de Rennes 1, F-35380 Paimpont, France.
SMF	Senckenberg Museum, Frankfurt, Germany.
SMND	Staatliches Museum für Naturkunde, Dresden, Germany.
SMNS	Staatliches Museum für Naturkunde, Stuttgart, Germany.
TM	Transvaal Museum, Pretoria, South Africa.
USNM	United States National Museum of Natural History, Smithsonian Institution, Washington, USA.
YPM	Yale Peabody Museum, New Haven, Conneticut, USA.
ZFMK	Museum Alexander Koenig, Bonn, Germany.
ZMA	Zoologisch Museum, Amsterdam, the Netherlands.
ZMB	Museum für Naturkunde, Humboldt University, Berlin, Germany.
ZMMU	Zoological Museum, Moscow University, Moscow, Russia.
ZMUC	Zoologisk Museum Universitet, Kobenhavn, Denmark.
ZMUZ	Zoologisches Museum der Universitat, Zurich, Switzerland.

Author The name of the author, or authors, is given at the end of each profile. All profiles should be cited using the author name(s).

Tables For selected taxa (mainly families and genera) tables (sometimes in the form of table-keys) provide details of the main characteristics of these taxa and can be used as an aid to identification. The tables were prepared by the editors.

Higher order profiles

The profiles for orders, families and genera are less structured than for the species profiles. Each profile usually begins with a listing of the taxa in the next lower taxon; for example, each family profile lists the genera in that family. An exception to this arrangement is where a taxon has only one lower taxon. Higher taxa profiles provide the characteristics common to all members of that taxon. Some of these characteristics may not be repeated in lower taxon profiles (unless essential for identification) so readers are encouraged to consult also the next higher taxon profile, e.g. the species profile for *Crocidura olivieri* should be consulted in association with the genus *Crocidura* profile. For the Chiroptera, the higher taxon profiles end with information that enables readers to recognize and distinguish the next lowest taxa (e.g. family profiles end with the diagnostic characters of the genera in that family).

Distribution maps

Each species profile, with a very few exceptions, contains a pan-African map showing the geographic range of the species. Most maps were provided by the author of the profile and were compiled from literature records and museum specimens; some maps were provided by the editor(s) when it was not possible for the author to do so. Each map shows the boundaries of the 47 countries of Africa, some of the major rivers (Nile, Niger–Benue, Congo [with the tributaries Ubangi, Lualaba and Lomani], Zambezi and Orange), and Lakes Chad, Tana, Turkana (formerly Rudolf), Albert, Edward, Victoria, Kyoga, Kivu, Tanganyika, Malawi, Mweru, Bangwuela and Kariba. The map projection is 'Transverse Mercator, with the following parameters: False Easting: 0; False Northing: 0; Central Meridian: 20; Linear Unit: metre; Datum: Clarke 1866'. The geographic

distribution of a species is indicated as:

- red shading = current range(s).
- × = individual localities when only a few localities are known, or isolated localities considered to be separate from the main geographic range(s). Some localities indicated by × may include two or more closely spaced localities.
- ? = locality of uncertain validity; relevant information usually in text.
- red arrow = recorded from the island indicated by the arrow.

Editors of *Mammals of Africa*

Jonathan Kingdon, Department of Zoology, University of Oxford, WildCRU, Tubney House, Abingdon Road, Tubney OX13 5QL, UK (Vols I, II, V & VI)
David Happold, Research School of Biology, Australian National University, Canberra, ACT 0200, Australia (Vols I, III & IV)
Thomas Butynski, Eastern Africa Primate Diversity and Conservation Program, PO Box 149, Nanyuki 10400, Kenya, and Zoological Society of London, King Khalid Wildlife Research Centre, Saudi Wildlife Authority, PO Box 61681, Riyadh 11575, Kingdom of Saudi Arabia (Vols I & II)
Michael Hoffmann, International Union for Conservation of Nature – Species Survival Commission, 219c Huntingdon Road, Cambridge CB3 0DL, UK (Vols I, V & VI)
Meredith Happold, Research School of Biology, Australian National University, Canberra, ACT 0200, Australia (Vols I & IV)
Jan Kalina, Soita Nyiro Conservancy, PO Box 149, Nanyuki 10400, Kenya (Vols I & II)

Order ERINACEOMORPHA – Hedgehogs

Erinaceomorpha Gregory, 1910.

Erinaceidae (3 genera, 6 species)	Spiny Hedgehogs	p. 29

The order Erinaceomorpha contains one family, ten genera and 20 species, distributed throughout Eurasia and Africa (Corbet 1988, Reeve 1994). The single family contains two subfamilies: the Galericinae (the Gymnures or Hairy Hedgehogs) and the Erinaceinae (the Spiny Hedgehogs). The five genera and six species of Hairy Hedgehogs live in the temperate and tropical forests of Asia, and are not considered further in this account. The Spiny Hedgehogs – usually referred to as just 'Hedgehogs' – occur widely in temperate Eurasia and Africa; currently, they are classified into five genera and 14 species, of which six species (in two or three genera) live in Africa.

The order (as family Erinaceidae) was previously included within the order Insectivora (Hutterer 2005a). Although the name Erinaceomorpha is not new – it was originally proposed by Gregory in 1910 – recent research has indicated that the Insectivora (hedgehogs and moonrats, shrews, moles, golden-moles, otter-shrews and tenrecs) are not a closely related group, and that the order Insectivora should be divided into three orders – Erinaceomorpha (hedgehogs and moonrats), Soricomorpha (shrews and moles) and Afrosoricida (golden-moles, otter-shrews, tenrecs). The following account deals only with the African hedgehogs – the sole representatives of the Erinaceomorpha in Africa.

The two best known characteristics of hedgehogs are their short pointed spines, which densely cover all of the back and flanks, and their ability to curl up into a ball when disturbed. Each spine is thought to be the equivalent of several hairs, where the follicles have coalesced, rather than of a single hair. The spines grow in lines, each spine pointing outwards in a slightly different direction; this results in a dense mat of spines that point in all directions. The spines are shed and replaced, just like normal hairs but more slowly. Hedgehogs can curl into a ball so that the head, limbs, tail and ventral surface are protected by the spiny back and flanks. Under the spiny skin are two large muscles, the orbicularis and panniculus carnosus, which encircle the back, chest and flanks forming a hood-like structure over the animal. Other muscles run downwards from the orbicularis and overlie the forehead, shoulders and rump; when a hedgehog is disturbed, these muscles contract very rapidly pulling the orbicularis downwards. At the same time, the orbicularis itself contracts and the whole body becomes enveloped within the stretched panniculus muscle. This movement stretches the very flexible skin and causes the spines to erect, providing additional protection (Reeve 1994). Hedgehogs can remain in this state for hours on end; they also roll up (but not so tightly) when asleep or in torpor and hibernation. Hedgehogs are characteristically parasitized by many fleas, which may be observed frequently among the spines.

Hedgehogs are small mammals, weighing on average 130–205 g as adults (African species). They are compact, rotund little animals because the neck, tail and limbs are short. The head is broad, the snout is slightly elongated and mobile, and the well-developed sense of smell is used for locating prey. The eyes are of moderate size but sight is primarily monochrome and highly developed. The ears vary from being quite small to very large, and hearing is very acute; some desert species have enlarged auditory bullae (as do some desert rodents), which enhances detection of very quiet noises in open spaces. Olfaction and hearing are the dominant senses for hedgehogs. The skull is strongly built with wide zygomatic arches so that the head appears rather broad. The dental formula is $I\ ^{3}/_{2}$, $C\ ^{1}/_{1}$, $P\ ^{3}/_{2}$, $M\ ^{3}/_{3} = 36$. The teeth are similar in structure and function to other small species of insectivores. One of the upper incisors is long and caniform, and points anteriorly. The canine teeth are small, as are the front premolars. The last premolar and the molars are large with well-developed pointed cusps that crush and slice through the exoskeletons of arthropod prey.

Hedgehogs live in a very wide range of habitats from cold temperate steppes to hot tropical savannas. In the cooler parts of their range (where sub-zero temperatures, frosts and snow occur in winter), they enter hibernation (see below). In the hotter parts of their range, they may be active all year, but may enter torpor during the dry season when food is scarce. Unlike many mammals, they adapt to human-modified environments and may be common (but rarely seen) in towns, cities and gardens. They do not live in rainforests or in very dry deserts. Although sometimes considered as rather 'primitive' mammals with rather few species, their widespread distribution and adaptability show that, as a family, they are very successful.

Hedgehogs are terrestrial, although some species are scansorial and can climb over logs and fences. They have short limbs, each with four or five digits ending in claws. They walk or trot on the soles of the feet, and can move surprisingly quickly for their size. They are nocturnal and active during most of the night, usually with peaks of activity before midnight and around 03:00h. During the day, they rest in a variety of habitats – under logs and piles of stones, in caves and rocky crevices, and in dense litter and hedgerows; some species dig burrows or rest in the burrows made by other animals. Surprisingly, most species can swim.

Hedgehogs are omnivorous, but their preferred prey is arthropods (mainly insects), earthworms, snails, small reptiles and eggs. Some species eat fruits and fungi in season. They appear to be resistant to toxins produced by some of their prey (such as centipedes and bees). When food is abundant, hedgehogs store fat under the skin and around some organs, and increase in weight. Fat is utilized (and weight declines) when food is scarce during the colder and drier months of the year.

Hedgehogs have the ability to change their metabolic rate in relation to environmental conditions. When the climate is cool or cold (and food may be limited), hedgehogs lower their metabolic rate and reduce their body temperature, and enter a state known as torpor or hibernation. The ability to hibernate is well understood and documented in temperate species, but it appears that African species enter torpor during the cold season of North Africa and South Africa, and during the dry season of tropical Africa. Torpor is physiologically different to hibernation and the metabolic rate

does not decline to the same extent, but it does enable individuals to reduce their energy expenditure and heat loss when environmental conditions are unfavourable.

African hedgehogs, like temperate ones, are mostly solitary. Very little is known about their behaviour and social organization in Africa. Likewise, little is known about their reproduction in the wild; the few observations that are available suggest that birth of young in most localities is seasonal. There are usually 2–6 young in a litter, and growth is rather slow. Most individuals probably do not breed until they are about a year old.

In Africa, fossil remains of hedgehogs are known from the early Miocene (Yates 1984). All the extant species of African hedgehogs are rather similar, but each of the six species has radiated into a different environment. The species are essentially allopatric with very limited overlap in their geographical ranges. African hedgehogs are found throughout the continent except in the Rainforest BZ and the driest parts of the Sahara and South-West Arid BZs.

D. C. D. Happold

Table 6. Characteristics of species in the family Erinaceidae in Africa. See also Figure 5.

Species	Mean HB (mm)	Central parting of spines	Surface of spines	Face-mask	Digit 1 on hindfoot	Ears (length as % of HF)	
Atelerix albiventris	167	Narrow	Smooth	Black; well defined, slight posterior extension on to lower cheek	Absent (or very rudimentary)	Small, rounded, shorter than adjacent spines (73%)	
Ateleris algirus	ca. 235	Narrow	Smooth	None; black 'spotting' on muzzle in some individuals	Small	Small, rounded, shorter than adjacent spines (77%)	
Atelerix frontalis	ca. 190	Narrow	Smooth	Black or dark brown; well defined, extends ventrally to merge with black ventral pelage	Small	Small, rounded, shorter than adjacent spines (76%)	
Atelerix sclateri	225	Narrow	Smooth	Black; well defined, extends slightly on to cheek	Small	Small, rounded, shorter than adjacent spines (88%)	
Hemiechinus auritus	179	Absent	Papillate with fine longitudinal grooves	None	Large	Large, considerably longer than adjacent spines (114%)	
Paraechinus aethiopicus	196	Wide	Papillate with fine longitudinal grooves	Black; well defined	Large	Large, slightly pointed, protrude above adjacent spines (132%)	

Family ERINACEIDAE

HEDGEHOGS

Erinaceidae G. Fischer, 1817. Mem. Soc. Imp. Nat., Moscow, 5: 372.

Atelerix (4 species)	Hedgehogs	p. 30
Hemiechinus (1 species)	Long-eared Hedgehog	p. 37
Paraechinus (1 species)	Ethiopian Hedgehog	p. 39

The family Erinaceidae occurs widely in temperate Eurasia and Africa; currently, they are classified into five genera and 14 species. Characteristics of the family are given in the order profile above.

African hedgehogs are placed in three genera, *Atelerix*, *Hemiechinus* and *Paraechinus* (Figure 4). *Atelerix* has been considered as a subgenus of *Erinaceus* (Corbet 1974a, Yates 1984), which contains several species of European and temperate Asian species, but Robbins & Setzer (1985) showed that it warrants generic distinction (see also Hutterer 2005a). The genera are distinguished by many characters (Figure 5, Table 6), the most important being the presence or absence of a central parting between the spines of the scalp (and if present, its comparative width), the presence or absence of papillae on the spines, the size of the ears and their size relative to the length of the adjacent spines, the form of some of the teeth, the width and form of the palatal shelf, the form of the auditory bullae and (in ♂♂) the structure of the glans penis (Corbet 1988). Compared with the European Hedgehog *Erinaceus europaeus*, there are few detailed studies on African hedgehogs, especially in the wild.

African hedgehogs range in size (mean HB) from 167 mm to ca. 235 mm. Species are considered as 'small' (mean HB of <180 mm), 'medium-sized' (mean HB 180–200 mm) or 'large' (mean HB >201 mm). Ear length is considered as 'small' (<30 mm) or 'large' (>30 mm) (see Table 6).

Atelerix albiventris.

Hemiechinus auritus.

Paraechinus aethiopicus.

Figure 4. The three genera of African hedgehogs.

	Colour of ventral pelage and limbs	Number of roots on premolar	Notes
	White; limbs pale	2	Widespread in savanna and semi-arid. Senegal to Ethiopia; E Africa north of Zambezi R.
	White; limbs pale	3	Morocco to Libya north of Sahara
	Grey to black; limbs grey to black	2 or 3	Southern Africa only
	White or buffy-white; limbs dark	2 (barely divergent)	Somalia
	White; limbs long, white	1, 2 (barely divergent), 3	Egypt and Libya
	White, dark posteriorly; limbs long, dark brown	1	Sahara Desert and surrounding semi-arid regions

The genera are distinguished by the presence/absence of the central parting on the forehead, whether the spines are papillate or smooth, and the width of the palatal shelf.

D. C. D. Happold

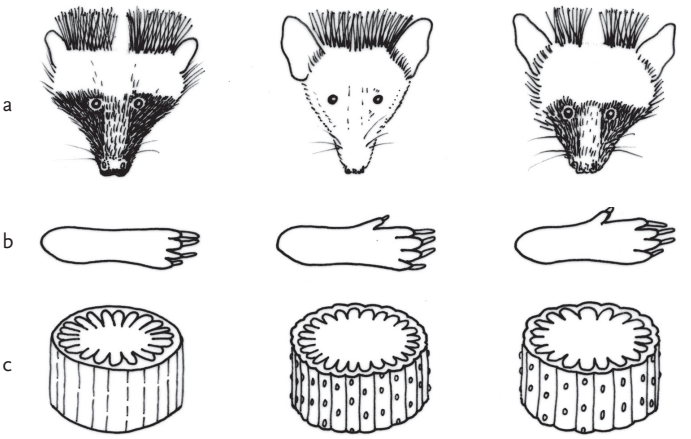


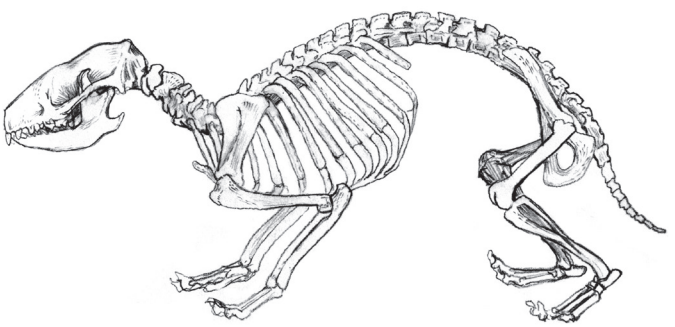
Figure 5. External characters of African hedgehogs: *Atelerix* (*left*), *Hemiechinus* (*centre*) and *Paraechinus* (*right*). (a) Head showing parting and face-mask. (b) Left hindfoot. (c) Section of spine. After Corbet (1988).

GENUS *Atelerix*
Hedgehogs

Atelerix Pomel, 1848. Arch. Sci. Phys. Nat. Geneve 9: 251. Type species: *Erinaceus albiventris* Wagner, 1841.

The genus *Atelerix* contains four species endemic to Africa, which occur throughout the savanna regions of the continent. All species in the genus have a narrow parting of the spines on the head, smooth spines (without papillae), rather small ears, broad palatal shelf and small auditory bullae (Figure 6). The hallux (Digit 1 of hindfoot) is small or absent. The genus *Atelerix* has often not been recognized, and the four species have been included within the genus *Erinaceus* (which includes three species very widely distributed in the Palaearctic regions). However, multivariate analysis of cranial characteristics (Robbins & Setzer 1985) as well as other non-cranial characters

Atelerix albiventris.



Atelerix sp.

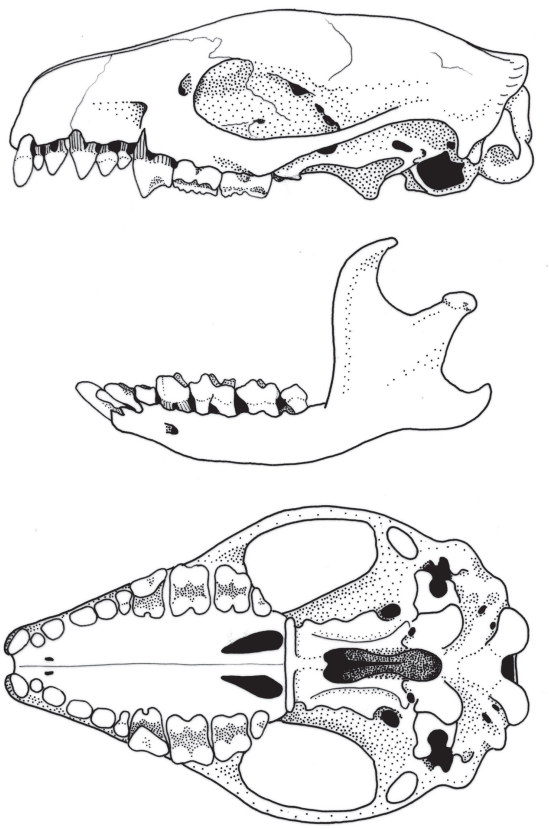


Figure 6. Skull and mandible of *Atelerix frontalis* (BMNH 34.10.10.213).

Atelerix albiventris.

and distribution patterns, clearly warrant separation of the African species in a separate genus (Corbet 1988, Hutterer 2005a). The four species are allopatric; one species – *A. albiventris* – is very widespread in central, East and West Africa, and the other species have more limited geographic distributions.

The species are distinguished by presence/absence of face-mask, colour of ventral pelage, presence/absence of Digit 1 on hindfoot, body size and geographic distribution (see Table 6).

D. C. D. Happold

Atelerix albiventris White-bellied Hedgehog (Four-toed Hedgehog)

Fr. Hérisson à ventre blanc; Ger. Weissbauchigel

Atelerix albiventris (Wagner, 1841). In Schreber. Die Saugethiere, Suppl. 2: 22. Probably Senegal or Gambia.

Taxonomy Originally described in the genus *Erinaceus*. The species, as now understood, includes many taxa originally considered to be species and subspecies; all are now treated as synonyms. Synonyms: *adansoni*, *atratus*, *diadematus*, *faradjius*, *heterodactylus*, *hindei*, *kilimanus*, *langi*, *lowei*, *oweni*, *pruneri*, *sotikae*, *spiculus*, *spinifex*. Subspecies: none recognized here; the large variation within populations suggests that subspecific differentiation is not justified (Corbet 1988, Reeve 1994). Chromosome number: 2n = 48, aFN = 96 (Hübner *et al.* 1991).

Description Small hedgehog with four digits on hindfoot. Dorsal pelage of dark spines; spines 15–20 mm, basal half off-white, terminal half dark brown or blackish-brown, often with white tip. Considerable variation in banding pattern on spines. Surface of spines smooth without papillae. Ventral pelage of non-spiny hairs; rather sparse; hairs white or buffy-white. Spiny dorsal pelage and hairy ventral pelage clearly delineated on lower flanks. Head with wide white forehead from cheek to cheek; narrow central parting of spines on crown of head; face-mask on muzzle and around eyes black, well-defined, extending posteriorly on lower cheek (see also below). Ears small, rounded, shorter than adjacent spines; ca. 73% of HF. Limbs short, white or pale; forefeet with five digits; hindfeet with four digits, Digit 1 absent or rudimentary. Tail relatively very short (ca. 7% of HB), barely visible, with small pale hairs. Nipples: not known. Glans penis without spiny or papillate pads. Some ♂♂ tend to be larger and heavier than ♀♀. Skull: auditory bullae comparatively small (see Measurements); P^3 with two roots. See Table 6.

Geographic Variation Specimens from drier habitats appear paler because they have a greater number of white-tipped spines; some individuals do not have a black face-mask.

Similar Species

Paraechinus aethiopicus. On average larger (HB: 196.1 [169–217] mm); wide central parting on crown; spines with papillae and grooves; ears much longer (41–45 mm), longer than adjacent spines; hindfeet with five digits; Sahara and northern semi-arid regions.

Atelerix sclateri. On average larger (HB: 225.0 [210–263] mm); Digit 1 of hindfoot present, small but not rudimentary; Somalia only.

A. frontalis. On average slightly larger (HB (♂♂): 185 [170–190] mm, HB (♀♀): 196 [186–210] mm); face-mask extending ventrally to merge with black ventral pelage; south of Zambezi R. only.

Distribution Endemic to Africa. The most widespread of the African hedgehogs. Recorded from Sudan Savanna and Guinea Savanna BZs, Northern and Eastern Rainforest–Savanna Mosaics and most of the Somalia–Masai Bushland BZ. Penetrates the northern margins of the Rainforest BZ where habitat destruction has created grasslands and cultivations. Recorded from Senegal to Ethiopia, Djibouti and Somalia, and southwards through East Africa to Zambia (north of the Zambezi R.) and Malawi. Only known overlap in geographic range with other species of hedgehogs is with *Paraechinus aethiopicus* in C Sudan and N Ethiopia (and possibly at other places where the northern savannas meet the Sahara Desert), and with *A. sclateri* in N Somalia. (Note: the record of this species from Liberia [Lienhardt 1982] is presumably an error.)

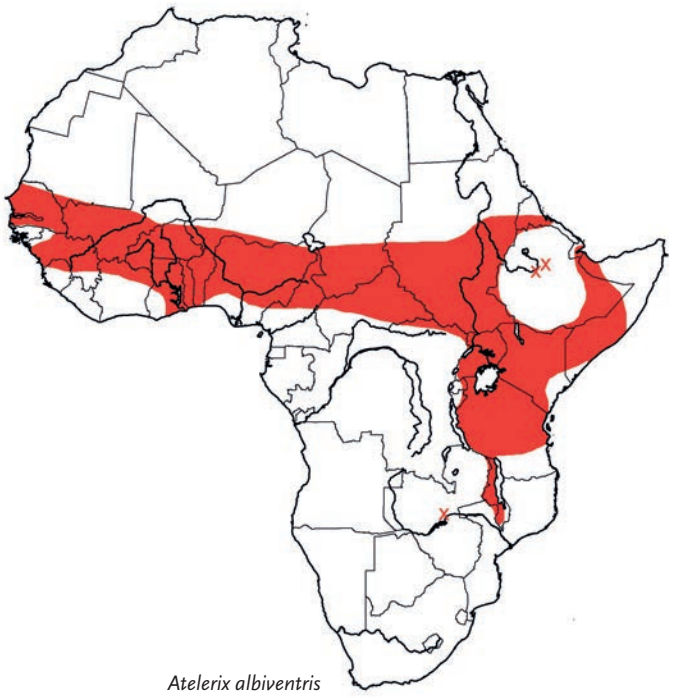
Habitat Savanna and semi-arid habitats, including rocky inselbergs. Tends to avoid waterlogged habitats, marshes and swamps. Often found in suburban gardens and cultivated fields.

Abundance May be common in suitable habitats. Individuals are seen more often at the beginning of the wet season when more individuals are killed by vehicles on roads.

Adaptations Nocturnal and terrestrial. During day, rests under rocks and logs, and in crevices and termitaria. In captivity, two peaks of nocturnal activity are evident: 21:00–24:00h and around 03:00h (Herter 1965). When active, hedgehogs walk and trot on all four limbs.

Body temperature (T_b) is maintained at 32.9–35.4 °C at normal ambient temperatures (Herter 1971). In captivity, when T_a is 19–24 °C, individuals become torpid and less active than normal. A similar drop in T_b is likely to occur in those regions where cool nights are experienced at some times of the year.

Foraging and Food Detailed information unavailable; probably similar to other species of hedgehogs (see order and family profiles).



Atelerix albiventris

In East Africa, the diet is reported to consist of earthworms, snails, slugs, crabs, fruit, fungi, roots and groundnuts (Kingdon 1974). Hedgehogs usually forage alone.

Social and Reproductive Behaviour Primarily solitary. Several vocal sounds are emitted, which enable communication between individuals and express mood. Five categories of audible vocal sounds have been recorded (Gregory 1975). (1) Twitter – a very quiet sound emitted through the closed mouth, and often accompanied by sniffing; usually associated with unfamiliar situations. Each twitter is of very short duration (5–40 msec) and several are emitted in pulses lasting for several seconds. (2) Hiss – a short noise of lower pitch than the twitter, emitted during stressful situations. (3) Snort – similar to the hiss, but louder and emitted when severely stressed or attacked, often repeated rapidly. (4) Scream – a rare sound, emitted under extreme stress. (5) Serenade – a series of low-pitched sounds ranging from a pure whistle to a course squawk, emitted by ♂♂ during courtship behaviour.

The faecal pellets have a strong odour, and may be a means of advertising the presence of an individual. Likewise, 'self-anointing' (licking the spines of the flank with copious amounts of saliva) may be a means of advertising and ensuring recognition (Reeve 1994).

Courtship behaviour is said to be similar to that of the European Hedgehog *Erinaceus europaeus* (M. W. Gregory, in Reeve 1994). When the ♂ approaches, the ♀ reacts aggressively, bristling her spines and snorting. The ♂ attempts to circle the ♀, who may try to run away; the ♀ responds by vigorously pushing the ♂ on his flank with the spines on her head. Such behaviour may last for minutes or hours. Copulation occurs when the ♂ mounts the ♀ from behind; the ♂ has a particularly long penis, perhaps because the spines on the rump of the ♀ prevent him from getting too close to the ♀.

Reproduction and Population Structure Times of reproductive activity vary in different parts of the range: probably active all year in East Africa (Kingdon 1974), but seasonal in drier and cooler habitats. Collections in Nairobi for a complete year include the following: pregnancies in Jul and Aug; litters in Apr–May; juveniles (<200 g) in Jan, Feb, Mar, Apr, May, Jun and Jul (Gregory 1976). Gestation: 35–37 days. Litter-size in captivity: 3.1 (1–6), n = 52 litters (1 young [n = 8], 2 [n = 14], 3 [n = 11], 4 [n = 6], 5 [n = 9], 6 [n = 4]). Young altricial at birth; WT: 5–11 g. Increase in weight is rapid: 25 g by Day 7, 50 g by Day 13, 70–75 g by Day 20, 110–120 g by Day 28, 130–150 g by Day 34, 170–190 g by Day 40 (Brodie *et al.* 1982, Lienhardt 1982). Maturity attained in ca. 5–6 months, but in the wild young probably do not breed until the next breeding season, when about one year old. Young are blind and naked at birth.

Predators, Parasites and Diseases The spines provide good protection against predators; however, remains of this species have been found in the pellets of Giant Eagle-owls *Bubo lacteus* in East Africa (Brown 1965) and in Nigeria (Happold 1987). In some parts of their geographical range, hedgehogs are eaten by humans, and they are vulnerable to being killed by vehicles on roads. In East Africa, the skin and spines are sometimes used as fertility charms.

Many ectoparasites have been recorded from hedgehogs in Kenya, Nairobi and Sudan, including fleas (*Ctenocephalaides felis*, *C. crataepus*,

Echidnophaga gallinacea, *Xenopsylla cheopis*), ticks (*Haemophysalis leachi*, *H. spinulosa*, *Rhipicephalus sanguineus*, *R. simus*) and mites (*Caparinia erinacei*, *Notoedres oudemansi*, *Rodentopus sciuri*, *Sarcoptes scabiei*) (Gregory 1981, Okaeme & Osakwe 1985, Reeve 1994). Hedgehogs are also hosts to endoparasites; in Nairobi many hedgehogs were parasitized by tapeworms, nematodes and acanthocephalines (Gregory 1981).

Conservation IUCN Category: Least Concern.
This widespread species is unlikely to be threatened at present.

Measurements
Atelerix albiventris
HB: 167.5 (140–258) mm, n = 10
T: 12.5 (9–16) mm, n = 10
HF: 27.2 (26–29) mm, n = 10
E: 19.9 (15–23) mm, n = 10
WT: 422 (270–680) g, n = 10
GLS: 43.5 (41.9–44.8) mm, n = 10
GWS: 28.0 (26.5–29.8) mm, n = 10
I^1–M^3: 21.5 (20.3–22.1) mm, n = 9
Auditory bulla: 4.6 (4.3–5.0) mm, n = 4*
Dakar, Senegal (ZFMK)
*Sudan (BMNH)

Key References Corbet 1988; Reeve 1994.

D. C. D. Happold

Atelerix algirus Algerian Hedgehog

Fr. Hérisson d'Algérie; Ger. Algerischer Igel

Atelerix algirus Lereboullet, 1842. Mem. Soc. Hist. Nat. Strasbourg 3 (2), art. QQ: 4. Oran, Algeria.

Taxonomy Synonyms: *caniculus*, *fallax*, *girbaensis*, *lavaudeni*, *vagans*. Subspecies: none recognized here. Several have been described for mainland and introduced island populations (see below); the insular populations show variation in pelage colouration but subspecific recognition is considered unwarranted by Corbet (1988). In contrast, Hutterer (2005a) recognizes *girbaensis* and *vagans* as subspecies. Chromosome number: not known.

Description Large hedgehog with five digits on hindfoot. Dorsal pelage of dark spines often with some pure white spines. Surface of spines smooth and without papillae. Ventral pelage of non-spiny hairs; hairs white or buffy-white, sometimes with dark patches. Spiny dorsal pelage and hairy ventral pelage clearly delineated on lower flanks. Head with wide white forehead from cheek to cheek; narrow central parting of spines on crown of head; muzzle white without dark face-mask (or with only a slight 'spotting' of dark hairs). Ears small, rounded, shorter than adjacent spines; ca. 77% of HF. Limbs short, white or pale; forefeet with five digits; hindfeet with five digits, Digit 1 may be slightly shorter than other digits. Tail relatively very short (<10% of HB), barely visible, with small pale hairs. Glans penis without spiny or papillate pads, expands laterally. Skull: auditory bullae moderate size; P^3 with three roots. Nipples: not known. See Table 6.

Geographic Variation Individuals from Morocco are paler than those from Algeria, Tunisia and Libya (Corbet 1988).

Similar Species
Paraechinus aethiopicus. Wide central parting on crown; spines with papillae and grooves; black face-mask; ears longer than adjacent spines; Sahara and northern semi-arid regions.
Hemiechinus auritus. No central parting on crown; spines with papillae and grooves; no face-mask; ears very large, much longer than adjacent spines; Egypt and Libya only.

Distribution Endemic to Africa. Mediterranean Coastal BZ and (infrequently) coastal regions of the Sahara Arid BZ. Recorded from Morocco, Algeria and Tunisia between the Mediterranean coast and the semi-arid habitats north of the Sahara Desert, including the Atlas Mts. In Libya, occurs only in a few localities near the coast, as far west as Cyreniaca. Djerba Is. (Tunisia). Introduced into several islands of the Balearic and Canary Is., and into parts of the Mediterranean coastal regions of France and Spain. Overlaps marginally with *Paraechinus aethiopicus* in the southern part of its range.

Habitat Mediterranean scrublands and grasslands, cultivations, palm groves and suburban gardens. May occur up to 2000 m in the Middle Atlas of Morocco (Aulagnier & Thévenot 1986).


Atelerix algirus

Abundance Common in cultivated regions and palm groves (Aulagnier & Thévenot 1986). In Libya, more abundant than the other two species of hedgehogs (*P. aethiopicus* and *H. auritus*).

Adaptations Nocturnal and terrestrial. It seems likely that Algerian Hedgehogs enter torpor during the winter.

Foraging and Food Primarily insectivorous and opportunistic; the diet includes worms, eggs and fruits (Aulagnier & Thévenot 1986), snails and insects (Hufnagl 1972). Introduced animals in the Balearic Is. are reported to feed on snails, centipedes, insects, snakes, lizards and a truffle-like fungus (J. A. Alcover, in Corbet 1988).

Social and Reproductive Behaviour No information.

Reproduction and Population Structure Reproduction appears to be limited to spring and summer. In Libya, breeding occurs from Apr to Jun, and occasionally a second litter is produced in Jul. Gestation: 30–48 days; litter-size: 3–7. Young remain close their mother for several months (Hufnagl 1972).

Predators, Parasites and Diseases Remains are infrequently found in owl pellets in Algeria (Kowalski & Rzebik-Kowalska 1991). May be eaten by humans in the Balearic Is. (Corbet 1988). Frequently killed by vehicles on roads in all parts of its range. Ectoparasites include the flea *Echidnophaga gallinacea* (also found on chickens); endoparasites include nematode worms (Reeve 1994).

Conservation IUCN Category: Least Concern.

Measurements
Atelerix algirus
HB: 200–270 mm
T: 15–30 mm
HF: 30–40 mm
E: 25–30 mm
WT: n. d.
GLS: 54.7 (43.6–58.3) mm, n = 8
GWS: 32.3 (27.4–34.6) mm, n = 7
I–M^3: 27. 8 (24.7–29.7) mm, n = 8
Auditory bulla: 6.6 (5.6–7.8) mm, n = 5*
Body measurements: Morocco (Aulagnier & Thévenot 1986; no means or sample sizes recorded)
Skull measurements: Algeria (Kowalski & Rzebik-Kowalska 1991)
*Algeria (BMNH)

Key References Aulagnier & Thévenot 1986; Corbet 1988; Hufnagl 1972; Kowalski & Rzebik-Kowalska 1991.

D. C. D. Happold

Atelerix frontalis Southern African Hedgehog

Fr. Hérisson du Cap; Ger. Kap-Igel

Atelerix frontalis (A. Smith, 1831). S. Afr. Quart. J., ser. 1, 5: 10. N Graaff Reinet district, South Africa.

Taxonomy Originally described in the genus *Erinaceus*. Synonyms: *angolensis*, *capensis*, *diadematus*, *fractilis*. Subspecies: two of uncertain validity. Chromosome number: not known.

Description Medium-sized hedgehog with five digits on hindfoot. Dorsal pelage of dark spines; spines white at base, with broad black or dark-brown subterminal bands and white or buffy tip. Surface of spines smooth without papillae. Ventral pelage of non-spiny hair, dark grey, brown or black. Head with white forehead; narrow central parting of spines on crown of head; black or dark brown face-mask on muzzle and around eyes extending posteriorly and ventrally to merge with the dark colouration on throat and chest (Figure 4). Ears small and rounded, shorter than adjacent spines; ca. 76% of HF. Limbs short, grey-brown to dark brown; hindfeet with five digits. Tail relatively very short (ca. 15% of HB). Nipples: 2 + 1 = 6. Skull: auditory bulla comparatively small.

Geographic Variation Shortridge (1934) and Meester *et al.* (1986) list two subspecies without comment:

A. f. angolae: SW Angola, N and C Namibia.
A. f. frontalis: W and C Zimbabwe, E Botswana and South Africa.

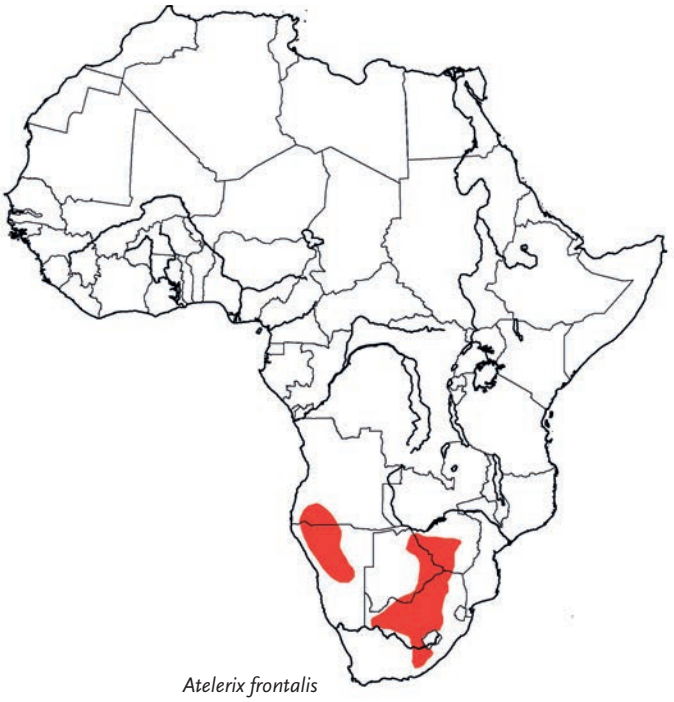
Similar Species
Atelerix albiventris. Ventral pelage white or buffy-white; four digits on HF; widespread in savanna habitats south of the Sahara and north of the Zambezi R. Allopatric.

Distribution Endemic to Africa. Zambezian Woodland BZ (SE and SW parts), Highveld BZ and parts of South-West Arid BZ (Karoo). Distribution disjunct with two separate ranges: (a) SW Angola, and N and C Namibia; (b) W and C Zimbabwe, E Botswana, and South Africa west of 31° E and southwards towards Grahamstown and the eastern Karoo (Smithers 1968, Rautenbach 1982, Lynch 1983, Skinner & Smithers 1990). Not recorded north of the Zambezi R. or from Swaziland (Monadjem 1998c) or KwaZulu–Natal (Taylor, P. 1998). Geographic range not known to overlap with *Atelerix albiventris*.

Habitat Occurs in many habitats in semi-arid and sub-temperate regions where annual rainfall is 300–800 mm and where there is ample ground cover. Not found in deserts or mesic habitats. Regularly found in suburban gardens.

Abundance Generally uncommon or rare (Shortridge 1934, Smithers 1983); tend to be commoner in suburban gardens where there is cover and food. In South Africa, numbers have declined with increased usage of domestic and agricultural pesticides.

Adaptations Terrestrial. Southern African Hedgehogs spend the day curled up in a ball under the cover of vegetation or in holes



Atelerix frontalis

in the ground, emerging in the evening to forage. Locomotion is slow, but agile when in flight. They are predominantly nocturnal, but exhibit some diurnal activity after rain has fallen, probably to feed on emerging earthworms.

Southern African Hedgehogs enter torpor during the cool dry season (= winter) when T_a is low. Torpor is characterized by low oxygen consumption, low respiration rate and a lowered body temperature. Experimental study has shown that at 15 °C and a 10 : 14 hour light : dark photoperiod, hedgehogs readily enter torpor. Similarly, on a restricted diet (about 40% of weekly maximum consumption) they display longer periods of torpor (Gillies *et al.* 1991). During torpor, fat reserves accumulated during the wet season are utilized to obtain energy (Smithers 1983). It appears that hedgehogs can modify the length of torpor in response to the availability of food and energy.

The timing and duration of torpor is likely to vary geographically. In the colder regions of the geographic range (eastern Free State, South Africa) where ambient temperatures fall to –9 °C during the winter, hedgehogs are inactive and remain in their burrows from Jun to Aug. During this period, there may be a 11–19% loss of body weight. If there is a warm spell during winter, hedgehogs may emerge and feed briefly before resuming torpor again (Smithers 1983). Torpor ends when temperatures increase in spring (Sep).

The dorsal spines are an effective means of defence when accompanied by rolling into a ball with the head, limbs and soft ventral surface in the centre. Smithers (1983) reported the sighting of a Lion *Panthera leo* in Hwange N. P., Zimbabwe, which was rolling a balled hedgehog between its paws and trying to bite it; the hedgehog survived and was none the worse for the encounter!

Foraging and Food Omnivorous. Hedgehogs forage in litter and just under the soil surface, and food is located mainly by scent. The diet includes variety of invertebrates such as beetles, earwigs, grasshoppers, termites, slugs and snails (which form the bulk of their diet) and small vertebrates such as small mammals, eggs and chicks of terrestrial birds, frogs and lizards. Some vegetable matter (e.g. fungi) may also be eaten. In captivity, hedgehogs eat invertebrates, minced beef, bread and dogfood (Smithers 1966, Smithers & Wilson 1979, Lynch 1989, Skinner & Smithers 1990). They do not seem to be dependent on free water, which is often not available, or available only seasonally, in their preferred habitat.

Social and Reproductive Behaviour Usually solitary, but also recorded in pairs and as a ♀ with young (Lynch 1983). Aggressive behaviour includes head butting accompanied by vocalizations that have been described as snuffling, snorting and growling. The alarm call is a high-pitched screech (Smithers 1983).

Females give birth to young in sheltered nests in debris or in holes lined with dry leaves. In the Free State, South Africa, they sometimes utilize termitaria for nesting (Lynch 1983). The young remain in or around the nest for 4–6 weeks after birth, and then can be seen foraging in the company of the ♀. Males do not participate in parental care (Skinner & Smithers 1990).

Reproduction and Population Structure Reproduction occurs during the warm wet summer months (Oct–Apr), and ♀♀ are seasonally polyoestrous. Gestation: 5–6 weeks. Litter-size: usually four (range 1–9; Smithers 1983). At birth: 5 cm in length, WT: 9 g, blind and hairless, ears closed, and rudimentary spines visible beneath skin. Development of spines is rapid; tips of unpigmented spines emerge through skin 1–3 h after birth and lengthen to about 6.5 mm by Day 2. Pigmented spines appear on Day 3, and by Day 7 a distinctly hedgehog-like appearance is attained and characteristic behaviour described as frowning, puffing and jerking is evident. Eyes open Day 10. Infant spines shed at 4–6 weeks. Weaned at about five weeks (Jacobsen 1982). A ♀ may produce more than one litter each year (Skinner & Smithers 1990).

Predators, Parasites and Diseases The Giant Eagle-owl *Bubo lacteus* preys on hedgehogs (Smithers 1968); when feeding, it peels and discards the spines from the body (Kemp & Calburn 1987). Some humans catch hedgehogs for food.

Conservation IUCN Category: Least Concern.

Originally listed as a threatened species but now thought to be less threatened. In South Africa, considered as 'rare' (Smithers 1986) and protected by local ordinances. Numbers have probably declined because of changing land-use and increased use of pesticides (which kill prey species).

Measurements

Atelerix frontalis frontalis
HB (♂♂): 185 (170–190) mm, n = 7
HB (♀♀): 196 (186–210) mm, n = 4
T (♂♂): 24 (20–30) mm, n = 7
T (♀♀): 24 (20–25) mm, n = 4
HF (♂♂): 34 (32–36) mm, n = 7
HF (♀♀): 34 (31–36) mm, n = 4
E (♂♂): 25 (20–27) mm, n = 7
E (♀♀): 27 (25–29) mm, n = 4
WT (♂♂): 362 (291–479) g, n = 9
WT (♀♀): 410, 450 g, n = 2
GLS: 47.4 (44.6–50.6) mm, n = 12

GWS: 29.2 (26.9–31.8) mm, n = 12
I^1–M^3: 23.4 (22.2–25.0) mm, n = 12
Auditory bulla: 5.3 (5.2–5.5) mm, n = 4
Body measurements and weight: Zimbabwe (Smithers & Wilson 1979)
Skull measurements: South Africa (BMNH)

Key References Gillies *et al.* 1991; Jacobsen 1982; Smithers 1983.

N. J. Dippenaar & R. M. Baxter

Atelerix sclateri Somali Hedgehog

Fr. Hérisson de Somalie; Ger. Somalischer Igel

Atelerix sclateri Anderson, 1895. Proc. Zool. Soc. Lond. 1895: 415. Taf, central Somalia.

Taxonomy The least well-known of African hedgehogs. Originally described in the genus *Erinaceus*, then moved to *Aethechinus*, but now considered to belong to *Atelerix* and closely related to *A. albiventris*. In N Somalia, populations of *A. sclateri* occur within about 100 km of populations of *A. albiventris* (Corbet 1988) without intergradation, and without any physical boundaries separating them. Possibly *sclateri* is a subspecies of *A. albiventris* (Corbet 1988). Synonyms: none. Chromosome number: not known.

Description Large hedgehog with five digits on hindfoot. Dorsal pelage of dark spines. Surface of spines smooth and without papillae. Ventral pelage of non-spiny hairs; hairs white or buffy-white with dark patches posteriorly. Spiny dorsal pelage and hairy ventral pelage clearly delineated on lower flanks. Head with white forehead from cheek to cheek; narrow central parting of spines on crown of head; black face-mask with slight posterior extension of black colouration on cheek. Ears small, rounded, shorter than adjacent spines; ca. 88% of HF. Limbs short, dark; forefeet with five digits; hindfeet with five digits, Digit 1 small. Tail very short with small pale hairs, barely visible. Nipples: not known. Glans penis – no information. Skull: auditory bullae comparatively small; P^3 with two roots, barely divergent. See Table 6.

Atelerix sclateri

Geographic Variation None recorded.

Similar Species

Atelerix albiventris. Four digits on HF; limbs pale; widespread in savanna habitats south of the Sahara and north of the Zambezi R. Allopatric.

Distribution Endemic to Africa. Somalia–Masai Bushland BZ. Known only from a few localities in N Somalia. Not recorded from neighbouring Djibouti (Pearch *et al.* 2001) or Ethiopia (Yalden *et al.* 1976).

Habitat Most specimens found on 'maritime plain close to hills' near Berbera. Altitude range: 10 m (near Berbera) to 1360 m (near Upper Sheik).

Abundance Uncertain; known from only a few specimens from about seven localities. Said to be 'fairly common on the maritime plain' (R. E. Drake-Brockman; label, BMNH).

Remarks Apparently no other information available. Presumed to be similar in many respects to other hedgehogs in arid habitats.

Conservation IUCN Category: Least Concern.

The few known specimens, small distribution and absence in locations where it would be expected to occur suggest that the species is threatened and should be classified as Vulnerable.

Measurements

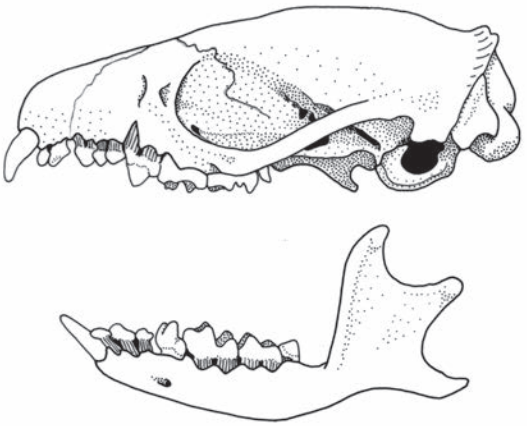
Atelerix sclateri
HB: 225.0 (206–263) mm, n = 4
T: 18.5 (14–20) mm, n = 4
HF: 26.8 (25–28) mm, n = 4
E: 24.0 (22–27) mm, n = 4
WT: n. d.
GLS: 41.8 (40.3–42.8) mm, n = 4
GWS: 25.1 (24.0–26.0) mm, n = 4
I^1–M^3: 20.0 (19.1–20.4) mm, n = 4
Auditory bulla: 4.6 (4.4–4.8) mm, n = 4
Somalia (BMNH)

Key Reference Corbet 1988.

D. C. D. Happold

GENUS *Hemiechinus*
Long-eared Hedgehog

Hemiechinus Fitzinger, 1866. Sitzb. Akad. Wiss. Wien 54, 1: 565. Type species: *Erinaceus platyotis* Sundevall, 1842 (= *Erinaceus auritus* Gmelin, 1770).



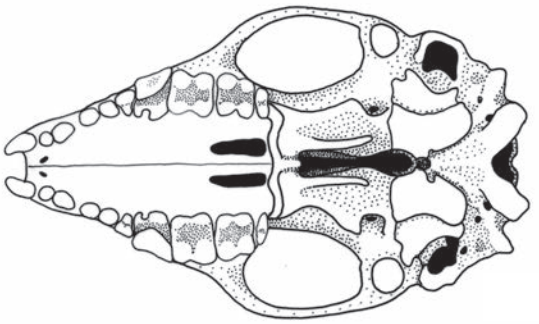


Figure 7. Skull and mandible of *Hemiechinus frontalis* (BMNH 92.7.1.2).

The genus contains four species widely distributed in the temperate and semi-desert regions from NE Africa and the Middle East to central China and NW India. Species in the genus are distinguished by the absence of a parting of the spines on the crown of the head, papillate spines with grooves, very large ears, narrow palatal shelf and enlarged auditory bullae (Figures 4 and 7). Digit 1 of the hindfoot is well developed. Hutterer (2005a) includes *Paraechinus* within this genus, but following Corbet (1988), *Paraechinus* is retained as a valid genus here. The single species in Africa, *Hemiechinus auritus*, occurs only in the extreme NE of the continent.

D. C. D. Happold

Hemiechinus auritus Long-eared Hedgehog

Fr. Hérisson à grandes oreilles; Ger. Langohr-Igel (Grossohrige)

Hemiechinus auritus (Gmelin, 1770). Nova Comm. Acad. Sci. Petropoli 14: 519. Astrakhan, S. Russia.

Taxonomy Originally described in the genus *Erinaceus*. A central Asian and Middle Eastern species, which has its extreme western boundary in coastal Egypt and Libya. Many synonyms (extralimital to Africa; see Corbet 1988, Hutterer, 1993, 2005a). Synonyms: many (mostly extralimital to Africa – see Hutterer 2005a). Subspecies: two (Egypt only). Chromosome number: 2n = 48, aFN = 92 (Hübner *et al.* 1991).

Description Small pale hedgehog with five digits on hindfoot. Dorsal pelage of dark spines; spines banded, whitish at base, with two wide black bands separated by white band, and white tip. Surface of spines rough with numerous papillae and with many shallow longitudinal grooves. Ventral pelage of non-spiny soft white hairs. Spiny dorsal pelage and hairy ventral pelage clearly delineated on lower flanks. Head white without dark face-mask; no central parting of spines on crown of head (cf. all other African hedgehogs). Ears large, slightly pointed, flexible and mobile, considerably longer than adjacent spines; ca. 114% of HF. Limbs rather long for a hedgehog, white; forefoot with five digits; hindfoot with five digits. Tail relatively very short and barely visible (ca. 15% of HB) with small pale hairs. Nipples: usually 5 pairs. Glans penis with two tracts of spines on upper surface; not expanded laterally. Skull: auditory bullae enlarged, but smaller than in *Paraechinus aethiopicus* (see Measurements); P^3 with 1–3 roots. See Table 6.

Geographic Variation Considerable variation throughout range. In Egypt, Osborn & Helmy (1980) recognize two subspecies:

H. a. aegyptius: Nile Delta and Sinai. Darker colouration, tail longer.
H. a. libycus: coastal desert regions west of the Nile Delta. Paler colouration, tail shorter.

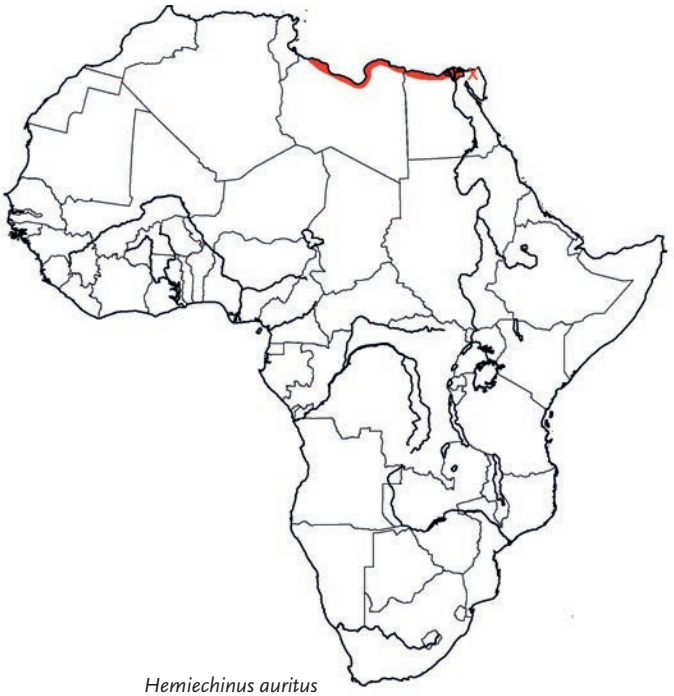
Similar Species

Paraechinus aethiopicus. Wide central parting on crown; black face-mask; Sahara and northern semi-arid regions.
Atelerix algirus. Narrow central parting on crown; spines smooth; ears shorter than adjacent spines; Morocco to Tunisia only.

Distribution North-eastern part of Sahara Arid BZ. Recorded from coastal Egypt and Libya. Extralimitally throughout Middle East, central Asia north of the Himalayan Mts to Mongolia and China (see Corbet 1988).

Habitat Coastal semi-desert and scrub with dense vegetation. Prefers mesic habitats such as gardens, olive groves and cultivated areas.

Abundance Not uncommon in suitable habitats.



Hemiechinus auritus

Adaptations Nocturnal and terrestrial. Although the Long-eared Hedgehog lives in semi-arid countries, it is not desert-adapted as is the Ethiopian Hedgehog *Paraechinus aethiopicus*. Nevertheless, it is moderately tolerant of heat and drought, and the large ears may be used for thermoregulation (Hufnagl 1972). During the day animals rest in burrows 20–90 cm long, which they dig themselves or in burrows originally made by rodents; at other times they rest in caves and crevices and under piles of rocks and bricks. Their long limbs enable them to walk and run quickly.

Comparative studies show that metabolic rate is 64% of that predicted on the basis of weight (cf. European Hedgehog *Erinaceus europaeus*: 98%). Evaporative water loss is similar to that of the European Hedgehog at low T_a, but lower at high T_a; for example, at $T_a = 30\,°C$ water loss is 1.0 ml/g/h and at $T_a = 40\,°C$ water loss is 4.0–8.2 ml/g/h (see also *Paraechinus aethiopicus*) (Shkolnik 1980). In this respect, Long-eared Hedgehogs fall midway between the temperate *Erinaceus europaeus* and the desert-adapted *Paraechinus aethiopicus*. During the cold season in North Africa (ca. Dec–Feb) they may go into torpor and remain in their burrows for periods of 5–40 days (Schoenfeld & Yom-Tov 1985).

Studies in Israel (where the climate is similar to that of North Africa) have revealed other aspects of the biology of the species (Schoenfeld & Yom-Tov 1985). During the course of a year, hedgehogs undergo regular fluctuations in weight. Mean maximum weight of 280 g is in summer (when food is abundant); weight declines in autumn to 260 g and to the minimum of 235 g during winter. Loss of weight is associated with torpor when hedgehogs utilize their fat reserves. In an area of ca. 500 ha, mean home-ranges were 4.9 ha for ♂♂ and 2.8 ha for ♀♀. Home-ranges for lactating ♀♀ were larger (mean = 3.5 ha) than for non-lactating ♀♀ (mean = 1.3 ha). Radio-tracking showed that individuals sometimes walk 1000 m during the course of night.

Foraging and Food Primarily insectivorous. In Israel, the diet (of this species and *Erinaceus europaeus*) included many insects (bugs, beetles, grasshoppers and ants), millipedes and snails. During spring, snails were a favoured food (Schoenfeld & Yom-Tov 1985).

Social and Reproductive Behaviour No information for Africa. Courtship behaviour is well developed, and includes sniffing, licking of the genitalia and flank-rubbing (Poduschka & Poduschka 1986, in Reeve 1994).

Reproduction and Population Structure In Egypt, litters of one and two young were recorded in May, and five in Aug (Flower 1932). Births were recorded in Jun (Israel; Schoenfeld & Yom-Tov 1985), and in Jun or Jul–Oct, with a peak in Aug (India; Prakash 1966 in Nader 1968). Litter-size: 2.5 (1–6) (Prakash 1960). Typically eyes open ca. Day 16, solid food eaten Day 21–28, and young are weaned at ca. Day 40 (Poduschka & Poduschka 1986).

Predators, Parasites and Diseases In Israel, ectoparasites include one species of tick *Rhipicephalus sanguineus* and one species of flea *Archaeopsylla erinacei* (Schoenfeld & Yom-Tov 1985). In Egypt, 11 species of fleas in seven genera have been recorded; many of these are widespread species, which also parasitize other mammalian species (Lewis 1967).

Conservation IUCN Category: Least Concern.
A widespread species and unlikely to be threatened.

Measurements
Hemiechinus auritus aegyptius
HB: 179.1 (156–206) mm, n = 35
T: 24.4 (18–39) mm, n = 36
HF: 35.9 (28–39) mm, n = 37
E: 41.0 (34–45) mm, n = 37
WT: up to ca. 500 g
GLS: 44.6 (42.4–46.7) mm, n = 32
GWS: 26.5 (24.1–29.7) mm, n = 32
I–M^3: 21.9 (19.3–23.9) mm, n = 20*
Auditory bulla: 6.5 (6.3–6.7) mm, n = 5**
Egypt (Osborn & Helmy 1980)
*Middle East (Harrison & Bates 1991)
**Egypt (BMNH)

Key References Osborn & Helmy 1980; Schoenfeld & Yom-Tov 1985.

D. C. D. Happold

GENUS *Paraechinus*
Desert Hedgehog

Paraechinus Troussart, 1879. Rev. et Mag. de Zool. 3 (7): 242. Type species: *Erinaceus micropus* Blyth.

Contains three species of 'desert hedgehogs', which live in arid habitats of North Africa and the Middle East. The genus is distinguished by the wide central parting of spines on crown of head, papillate spines with grooves, large ears, broad palatal shelf and especially enlarged auditory bullae (Figures 4 and 8). Digit 1 of hindfoot is well developed (cf. *Atelerix* spp.). Members of the genus are better adapted to arid conditions than other hedgehogs. *Paraechinus* is considered to be a subgenus of *Hemiechinus* by Hutterer (1993, 2005a), although retained as a valid genus by Corbet (1988). The single African species occurs only in the arid and semi-arid regions in and around the Sahara Desert.

D. C. D. Happold

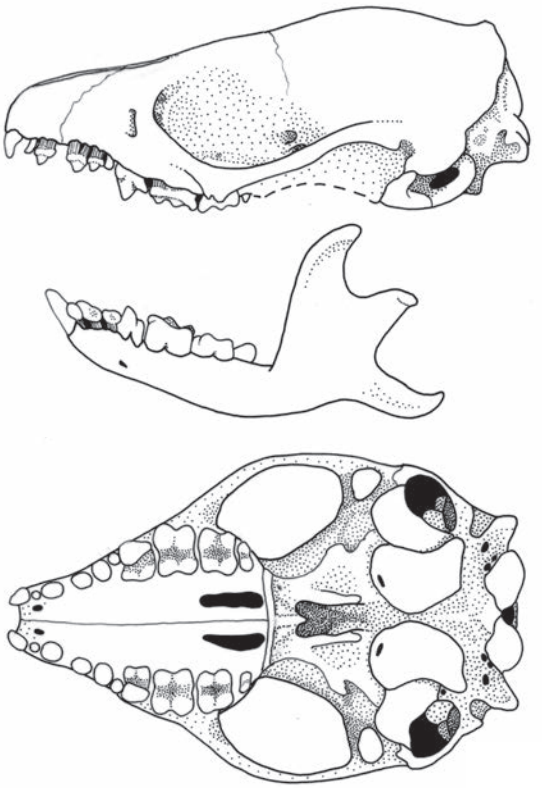


Figure 8. Skull and mandible of *Paraechinus aethiopicus* (BMNH 66.5581).

Paraechinus aethiopicus Desert Hedgehog (Ethiopian Hedgehog)

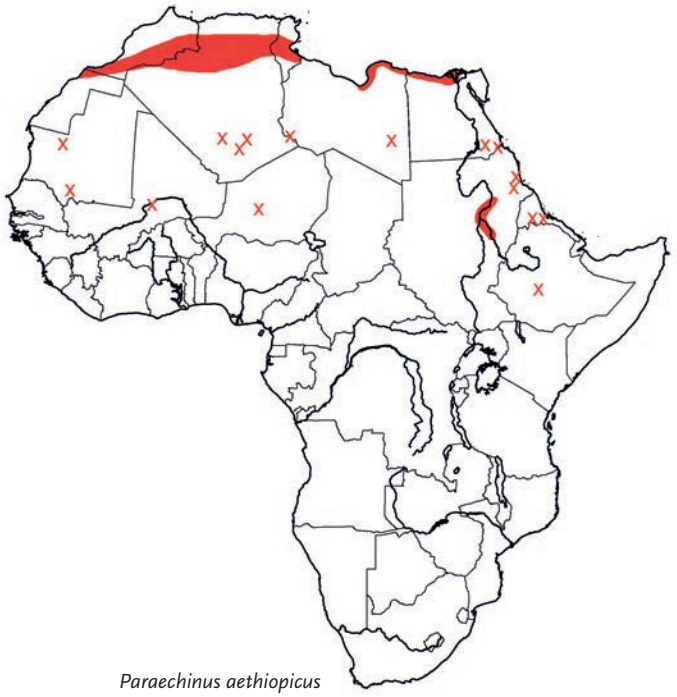
Fr. Hérisson du désert; Ger. Wüstenigel

Paraechinus aethiopicus (Ehrenberg, 1832). Symb. Phys. Mamm. 2; footnote. Dongola desert, Sudan.

Taxonomy Originally described in the genus *Erinaceus*. The widespread distribution, and the large amount of individual variation, has resulted in many names, at species and subspecies level, being applied to this species. Osborn & Helmy (1980) regard *aethiopicus*, *dorsalis* and *deserti*, all of which occur in Egypt, as full species, a view not supported by Corbet (1988) and Hutterer (1993, 2005a). Here, placed in the genus *Paraechinus* (following Corbet 1988), not in the genus *Hemiechinus* as given by Hutterer (2005a). See also genus profile. Synonyms: *albatus*, *albior*, *blancalis*, *brachydactylus*, *deserti*, *dorsalis*, *ludlowi*, *oniscus*, *pallidus*, *pectoralis*, *senaariensis*, *wassifi*. Subspecies: none recognized here. Chromosome number: 2n = 48, FN = 90 (Saudi Arabia; Harrison & Bates 1991).

Description Medium-sized hedgehog with five digits on hindfoot (as in *Hemiechinus*). Dorsal pelage of dark spines; spines banded, whitish at base, with two wide black bands separated by white band, and white tip. Surface of spines rough with numerous papillae and with many shallow longitudinal grooves. Ventral pelage of non-spiny hairs; rather sparse; hairs mostly white but may be brown posteriorly or have brown patches on chest in some individuals. Spiny dorsal pelage and hairy ventral pelage clearly delineated on lower flanks. Head with broad white forehead from cheek to cheek; wide central parting of spines on crown of head; face-mask on muzzle and around eyes black, well defined, extending posteriorly on to the lower cheek (see also below). Ears large, slightly pointed, usually longer than adjacent spines; ca. 132% of HF. Limbs rather long for a hedgehog, dark brown; forefeet with five digits; hindfeet with five digits (Digit 1 may be slightly reduced). Tail relatively very short (<1% of HB), barely visible, with small pale hairs. Glans penis with two tracts of spines (sometimes each with two rows of spines) on upper surface. Skull: auditory bullae enlarged (more so than in other species of hedgehogs; see Measurements); P^3 with one root. Nipples: four pairs. See Table 6.

Geographic Variation There is considerable variation in the extent of the brown colouration of the ventral pelage in different parts of the range.



Paraechinus aethiopicus

Similar Species

Atelerix albiventris. Narrow central parting on crown; spines smooth; four digits on HF; ears shorter than adjacent spines; widespread in savanna habitats south of the Sahara and north of the Zambezi R.

A. algirus. Narrow central parting on crown; spines smooth; no face-mask (some 'spotting' on muzzle); five digits on HF; ears shorter than adjacent spines; Morocco to Tunisia only.

Hemiechinus auritus. No central parting on crown; no face-mask; five digits on HF; ears very large, much longer than adjacent spines; Egypt and Libya only.

Distribution Sahara Arid BZ and in the semi-arid regions to the north and south of the desert. Widely distributed. Recorded from Mauritania and Morocco to Egypt, Sudan and N Ethiopia. Also Djerba I. (Tunisia). Populations are mostly scattered and isolated (as a result of increasing aridity in the area of distribution in recent millennia). Not recorded from coastal regions of Morocco, Algeria or Tunisia. Also occurs extralimitally in Saudi Arabia, Israel, Jordan, Iraq and the Gulf States (Harrison & Bates 1991).

Habitat Desert and dry scrub, often on stony plains, jebels and in mountainous desert country (e.g. Hoggar); also in more mesic regions such as near oases and vegetated wadis.

Abundance Generally uncommon, but may be common in selected localities. Populations are scattered and isolated, and do not occur throughout the whole geographic range. Not uncommon in (irrigated) gardens and fields in parts of the range (e.g. Libya; Hufnagl 1972).

Adaptations Little is known about this species in the wild (Corbet 1988). Desert Hedgehogs appear to be better adapted to arid conditions than the other species of African hedgehogs. Nocturnal and terrestrial. During the day, rest in crevices in cliffs, under clumps of vegetation, or in burrows and, unlike other hedgehogs, may dig their own burrows (Herter 1968). During the winter (cool season) in the desert, when the night air is cold and food is less abundant, they enter torpor (and hence are rarely seen). In Algeria, hedgehogs are torpid during the months of Nov–Mar (Kowalski & Rzebik-Kowalska 1991); during these months they usually emerge every few days to feed (Harrison & Bates 1991).

Desert hedgehogs show two adaptations that are clearly associated with the desert habitat: low metabolic rate and low evaporative water loss. In captive animals, metabolic rate (as measured by oxygen consumption) is only 51% of what is predicted on the basis of weight (cf. European Hedgehog: 98%). Evaporative water loss is comparatively lower than that of the European Hedgehog; for example, in the Desert Hedgehog at $T_a = 30\,°C$ water loss is 0.55 ml/g/h; at $T_a = 40\,°C$ water loss is 3.3–4.5 ml/g/h; equivalent figures for the European Hedgehog are 2.6 and 6.7–10 ml/g/h) (Shkolnik 1980). T_b at normal T_a is around 34 °C; there is no information on the T_b of torpid Desert Hedgehogs.

Long limbs enable fast walking and trotting: one individual was followed at a steady 10 km/h for five minutes in Libya (Hufnagl 1972).

Foraging and Food Primarily insectivorous. In Algeria, the diet comprises insects, eggs, agamid lizards and snakes, and they are also reported to eat scorpions (Sellami *et al.* 1989, Kowalski & Rzebik-Kowalska 1991).

Social and Reproductive Behaviour No information.

Reproduction and Population Structure Litter-size: 2–5. Weight of young at birth: 8–9 g. Growth rate: 20 g at Day 10; 40 g at Day 20; 60 g at Day 30; 80 g at Day 40; 150 g at Day 60. Growth rate to 6 weeks: 1.7 g/day; from 6 to 9 weeks: 3.5 g/day. Eyes open: Day 21–22. Solid foods eaten: Day 44. Fully weaned: Day 58 (Eisentraut 1952, Reeve 1994). Growth to weaning is longer than in other species of hedgehogs. Thermoregulation fully developed at about Day 44 when solid food is first eaten. No information on number of litters/year, or on average longevity.

Predators, Parasites and Diseases In Algeria, hunted by jackals. Remains of young hedgehogs found in the pellets of owls (species unknown) (Kowalski & Rzebik-Kowalska 1991). Also eaten by humans in some parts of the range (e.g. in Algeria; Sellami *et al.* 1989). Two species of fleas recorded on Desert Hedgehogs in Egypt: *Synosternus pallidus* (common on several species of hedgehogs and carnivores) and *S. cleopatrae* (common on gerbils) (Lewis 1967).

Conservation IUCN Category: Least Concern.

Measurements

Paraechinus aethiopicus
HB: 196.1 (169–217) mm, n = 7
T: 19.1 (15–22) mm, n = 7
HF: 32.8 (30–37) mm, n = 7
E: 43.6 (41–45) mm, n = 7
WT: ca. 500 g
GLS: 43.4 (41.1–45.1) mm, n = 8

GWS: 26.5 (25.1–27.5) mm, n = 8
I^1–M^3: 20.5 (19.8–21.5) mm, n = 8
Auditory bulla: 9.4 (8.6–10.3) mm, n = 6
Body measurements and weight: Egypt (Osborn & Helmy 1980)
Skull measurements: Egypt and Sudan (BMNH)

Key References Corbet 1988; Eisentraut 1952; Reeve 1994.

D. C. D. Happold

Order SORICOMORPHA – Shrews, Moles, Shrew Moles, Desmans and Solenodons

Soricomorpha Gregory, 1910. Bull. Amer. Mus. Nat. Hist. 37: 465.

Soricidae (9 genera, 150 species)	Shrews	p. 43

The order Soricomorpha includes a multitude of shrew-like forms that feed primarily on invertebrates, including insects, other arthropods, molluscs and earthworms. They have elongated, flexible snouts, prominent vibrissae and numerous small pointed teeth. The external ears are small and rounded. The eyes are minute. The pelage is short and dense with a velvety touch. They are mostly terrestrial and ground-dwelling, and run with a plantigrade gait. They include some of the smallest of all living mammals, and range in size from the tiny shrews such as *Suncus etruscus* and *Sorex minutissimus* weighing 1.5–2 g, to the stoutly built solenodons such as *Solenodon paradoxus*, weighing up to 1 kg. Although soricomorphs resemble more closely the generalized, primitive mammalian condition than other Recent placental mammals, the earlier viewpoint that they were ancestral to the other eutherian (placental) orders of mammals and defined by primitive characters has largely been abandoned (Butler, 1988). Their geological range is early Eocene to Recent (Miocene to Recent in Africa).

Extant members of the Soricomorpha are distributed widely throughout Eurasia, North America, Africa and southern Asia. Only after the formation of the Pliocene land bridge did they reach South America, but only one genus, the shrew *Cryptotis*, has successfully colonized the Neotropics. They have never been present in Australia and are absent from the polar regions.

The soricomorphs (as currently understood) were previously assigned to the order Insectivora, along with many other small fossil and extant mammals with primitive characters such as hedgehogs (Erinaceidae), golden-moles (Chrysochloridae), tenrecs (Tenrecidae) and elephant shrews or sengis (Macroscelidae). It was long argued that, because of the primitive features possessed by all these insectivorous mammals, they exhibit closer affiliations with the ancestral stock of mammals than do any other living groups. However, the composition of the group has never been fully agreed upon and the proposal that they represent a monophyletic group descended from a single common ancestor has been hotly debated. Cladistic analysis suggests that living insectivores are united by derived anatomical features (MacPhee & Novacek 1993). Molecular studies have cast further doubt on the phylogeny and affiliations of these insectivorous mammals and alternative groupings have been proposed (Springer *et al.* 1997, Stanhope *et al.* 1998, Madsen *et al.* 2001, Murphy *et al.* 2001a).

The taxonomy adopted by Wilson & Reeder (2005) is followed here: the order Insectivora is replaced by three orders, these being Afrosoricida (Tenrecidae, Chrysochloridae), Erinaceomorpha (Erinaceidae) and Soricomorpha (Soricidae [shrews], Talpidae [moles, shrew moles and desmans], Solenodontidae [solenodons] and the extinct Nesophontidae [West Indian shrews]). The Macroscelidae has, for many years, been placed in an order of its own, the Macroscelidea (Schlitter 1993, 2005). The Afrosoricida and Macroscelidae are now placed in the Afrotheria (see Volume I of *Mammals of Africa*). Within the Soricomorpha, only the Soricidae are found in Africa. In comparison with the wealth of information about the biology and ecology of shrews from temperate regions, African species are poorly documented.

Sara Churchfield

Table 7. Genera in the family Soricidae.

Genera (number of species)	Long hairs on tail	External ear	Very long claws on forefeet	Number of upper unicuspid teeth	P_3	Crown pattern on P_4	Vascular foramina on cranium	Notes
Congosorex (3 spp.)	Absent	Very reduced	No	3	Absent or present	Myosorine	Present	Rainforests of DR Congo and Congo
Crocidura (106 spp.)	Present	Large	No	3	Absent	Crocidurine	Absent	All of Africa
Myosorex (14 spp.)	Absent	Reduced	No	4	Present	Myosorine	Present	Mountains of central and East Africa; southern Africa
Paracrocidura (3 spp.)	Present	Reduced	No	3	Absent	Crocidurine	Absent	Montane and rainforest of central Africa
Ruwenzorisorex (1 spp.)	Absent	Reduced	No	4	Absent	Crocidurine	Absent	Mountains of Albertine Rift Valley
Scutisorex (1 spp.)	Absent	Large	No	4	Absent	Crocidurine	Absent	E DR Congo, Uganda
Suncus (7 spp.)	Usually present	Large	No	4	Absent	Crocidurine	Absent	Widespread, but not western Africa
Surdisorex (2 spp.)	Absent	Absent	Yes	3	Absent	Myosorine	Present	Mt Kenya and Aberdare highlands. Fossorial
Sylvisorex (13 spp.)	Usually absent	Large	No	4	Absent	Crocidurine	Absent	Rainforest and montane forests of central and East Africa

Family SORICIDAE

SHREWS

Soricidae Fischer, 1815. Mem. Soc. Imp. Nat. Moscow 5: 372.

The family Soricidae – the shrews – contains 23 Recent genera and some 374 species (Hutterer 2005b), and has many more representatives than any other family of insectivorous mammals. The Soricidae has radiated to fill the terrestrial insectivore niche in most habitats in both temperate and tropical regions. It has the widest distribution of any family of insectivorous mammals, being found in Eurasia, South-East Asia and the Americas, as well as in Africa. Shrews are by far the most numerous and widespread of the terrestrial insectivorous mammals found in Africa. The number of species of shrews in Africa is uncertain and is under constant review as more species are encountered, particularly in little-known forested and montane areas, and as other previously described taxa are placed in synonomy. Wolsan & Hutterer (1998) record 149 species of shrews in Africa, and Hutterer (2005b) lists 148 species. Here, nine genera and 150 species are recognized (Tables 7 and 8). Within the Soricidae, three clades are recognized, supported by allozyme data and rRNA sequence data (Maddalena & Bronner 1992, Quérouil *et al.* 2001). Hutterer (2005b) retains these clades at the subfamily level: Soricinae (red-toothed shrews), Crocidurinae (white-toothed shrews) and Myosoricinae. All African shrews are members of the Crocidurinae or Myosoricinae, and the most widespread genus is *Crocidura*, with ca. 105 species recognized at present. The taxonomy of *Crocidura* is complex and some species are morphologically so similar that they are assigned to 'species groups'. Multivariate analyses of morphological characters to distinguish species is hampered by the lack of specimens available in many cases but recent genetic analyses are providing a means of differentiating morphologically similar species, and molecular approaches are giving further insights into species boundaries and phylogenetic relationships within African *Crocidura* species groups (e.g. Quérouil *et al.* 2001, 2005). This profile from here on primarily pertains to the Soricidae of Africa. Detailed information on the natural history of shrews is given by Churchfield (1990).

Table 8. Shrews of Africa arranged by size (mean HB and then CI) within eight size categories.

Habitat: a = arid/semi-arid, s = savanna, f = rainforest, fs = rainforest + savanna, m = montane, com = commensal.

Regions: c = central Africa, e = eastern Africa, n = northern Africa, s = southern Africa, w = western Africa, ec = east-central Africa.

Genus	Species	Mean HB (mm)	Mean CI (mm)	T % of HB (approx)	Habitat	Regions
MINUTE (mean HB: <50 mm)						
Crocidura	*nana*	40	16	75	s	e
Suncus	*etruscus*	44	13	60	s	n
Crocidura	*pasha*	46	14	70	a	w, e
Suncus	*remyi*	47	13	41	f	c
Crocidura	*obscurior*	48	15	60–70	f	w
Crocidura	*bottegi*	48	16	60	m	e
Sylvisorex	*johnstoni*	49	15	50–60	f	w, c
VERY SMALL (mean HB: 50–59 mm)						
Crocidura	*nanilla*	50	15	70	s	e
Sylvisorex	*vulcanorum*	50	16	100	m	ec
Crocidura	*pitmani*	50	18	72	s?	c
Suncus	*infinitesimus*	51	15	55	f, s	s
Myosorex	*schalleri* (juvenile)	53	9	80	m	ec
Suncus	*hututsi*	53	14	60	m	ec
Crocidura	*douceti*	53	17	80	f, fs	w
Crocidura	*religiosa*	54	15	65	a	n
Crocidura	*bottegoides*	54	15	82	m	e
Suncus	*varilla*	56	16	60	s	s, e
Sylvisorex	*granti*	56	17	100	m	e
Crocidura	*yankariensis*	56	19	67	s	w, e

Genus	Species	Mean HB (mm)	Mean CI (mm)	T % of HB (approx)	Habitat	Regions
Crocidura	*ansellorum*	57	17	80	s	c
Crocidura	*fuscomurina*	58	16	65	s	w, e, s
Crocidura	*polia*	58	18	124	f, s?	c
Sylvisorex	*camerunensis*	58	18	100	m	w
Congosorex	*verheyeni*	59	18	32	f	c
Sylvisorex	*isabellae*	59	19	90	m	w
Crocidura	*cinderella*	59	19	70	s	w
SMALL (mean HB: 60–69 mm)						
Crocidura	*lusitania*	60	16	56	s	w, e?
Crocidura	*aleksandrisi*	60	17	70	a	n
Crocidura	*allex*	60	17	82	m	e
Congosorex	*polli*	60	20	40	rs	c
Crocidura	*planiceps*	61	17	72–78	s	w, e
Crocidura	*whitakeri*	61	17	50	a	n
Crocidura	*muricauda*	61	18	120–150	f	w
Suncus	*megalura*	61	18	118	s	w, e, c
Crocidura	*virgata*	61	20	65	m	w
Sylvisorex	*howelli*	62	16	70	m	e
Crocidura	*elgonius*	62	17	55	m	e
Crocidura	*maquassiensis*	62	19	71	m, s	s
Crocidura	*denti*	63	21	65–70	f	c, w?
Sylvisorex	*konganensis*	64	17	56	f	c
Crocidura	*floweri*	64	18	75–100	a	n
Crocidura	*tarfayensis*	64	19	60	a	n
Crocidura	*somalica*	64	20	66	a	e
Crocidura	*gracilipes*	65	n. d.	80	m	e
Crocidura	*dolichura*	65	19	125–150	f	w, c
Crocidura	*ludia*	66	18	84–87	f	c
Sylvisorex	*morio*	67	20	75	m	w
Crocidura	*roosevelti*	67	22	85	f, s	c, e
Crocidura	*crossei*	68	19	84	f	w
Crocidura	*phaeura*	68	20	53	m	e
Sylvisorex	*oriundus*	68	21	91	?	c
Crocidura	*russula*	69	19	50	s	n
Crocidura	*silacea*	69	20	70	f, s	s
Suncus	*lixus*	69	20	64	f, s	w, e, s
SMALL–MEDIUM (mean HB: 70–79 mm)						
Crocidura	*harenna*	70	19	66	m	e
Crocidura	*macowi*	70	20	80	s?	e
Crocidura	*caliginea*	70	22	70	f	c
Congosorex	*phillipsorum*	71	19	55–60	m	s
Crocidura	*greenwoodi*	71	21	72	f, s	e
Crocidura	*hildegardeae*	72	19	70	m	e
Crocidura	*crenata*	72	19	120	f	c
Crocidura	*eisentrauti*	72	20	79	m	w
Myosorex	*geata*	72	21	57	m	e
Crocidura	*jacksoni*	73	21	75	f	e
Myosorex	*okuensis*	73	22	55	m	w
Sylvisorex	*pluvialis*	74	19	90	f	c

Genus	Species	Mean HB (mm)	Mean CI (mm)	T % of HB (approx)	Habitat	Regions
Crocidura	*niobe*	74	20	82	m	ec
Crocidura	*smithii*	74	21	54	s?	e
Crocidura	*nigricans*	74	22	75	m	c
Crocidura	*kivuana*	75	21	89	m	ec
Crocidura	*jouvenetae*	75	22	66	f	w
Crocidura	*glassi*	75	23	67	m	e
Crocidura	*latona*	76	20	85	f	c
Crocidura	*congobelgica*	76	21	75	f	c
Crocidura	*picea*	76	22	55	m	w
Paracrocidura	*schoutendeni*	76	23	50	f	c
Crocidura	*parvipes*	77	20	45–60	s	c, e
Myosorex	*kihaulei*	77	20	53	m	e
Suncus	*aequatorius*	77	21	78	f	e
Myosorex	*eisentrauti*	77	23	45–55	f	w
Crocidura	*macmillani*	77	23	70	m	e
Crocidura	*monax*	77	24	70	m	e
Crocidura	*montis*	78	22	72	m	e
Crocidura	*macarthuri*	78	23	56	s	e
Crocidura	*batesi*	78	24	60–75	f	w, c
MEDIUM (mean HB: 80–89 mm)						
Crocidura	*fumosa*	80	21	50–80	m	e
Crocidura	*mariquensis*	80	21	70	s	c, s
Sylvisorex	*lunaris*	80	23	65	m	ec
Crocidura	*attila*	81	21	55–65	m	w, c?
Crocidura	*usambarae*	81	22	70	m	e
Crocidura	*grassei*	81	23	95	f	c
Crocidura	*cyanea*	82	21	69	fs	s
Crocidura	*manengubae*	82	22	75	m	w
Crocidura	*voi*	82	23	45–55	?	w, e
Crocidura	*nimbae*	82	26	40	f, s	w
Myosorex	*varius*	83	22	50	s	s
Myosorex	*tenuis*	83	22	41–59	s	s
Crocidura	*selina*	83	23	70	f	e
Myosorex	*longicaudatus*	83	23	79	f	s
Paracrocidura	*graueri*	83	28	55	m	ec
Myosorex	*rumpii*	84	23	40	m	w
Crocidura	*nigrofusca*	84	24	75	f	e, c
Crocidura	*poensis*	84	24	75	f	w
Myosorex	*babaulti*	85	22	45	m	ec
Crocidura	*luna*	85	23	61	f, s	e
Crocidura	*wimmeri*	85	25	75	f	w
Crocidura	*buettikoferi*	86	21	70	f	w
Myosorex	*blarina*	86	22	42	m	ec
Crocidura	*baileyi*	86	22	51	m	e
Crocidura	*lucina*	86	23	62	m	e
Crocidura	*hirta*	86	23	55–90	m, s	e, s
Crocidura	*fischeri*	86	27	53–59	s	e
Crocidura	*lamottei*	87	25	53	f, s	w
Crocidura	*thalia*	87	25	70	m	e
Crocidura	*maurisca*	88 /79	21	89	s	ec

Genus	Species	Mean HB (mm)	Mean CI (mm)	T % of HB (approx)	Habitat	Regions
Myosorex	*cafer*	88	23	50	f	s
Crocidura	*desperata*	89	26	75	m	e
LARGE (mean HB: 90–99 mm)						
Crocidura	*ultima*	90	23	70	m	e
Crocidura	*viaria*	90	25	70	a	n, w, e
Surdisorex	*polulus*	90	25	30	m	e
Crocidura	*theresae*	91	23	52	s	w
Crocidura	*raineyi*	91	25	69	?	e
Crocidura	*tarella*	91	25	63	f	e
Crocidura	*stenocephala*	92	24	77	m	ec
Paracrocidura	*maxima*	92	26	53	m	ec
Crocidura	*xantippe*	93	23	66	s	e
Crocidura	*littoralis*	93	24	73	f	c
Myosorex	*zinki*	94	23	38	m	e
Myosorex	*sclateri*	94	25	43–63	s	s
Crocidura	*erica*	96	22	56	s?	c
Crocidura	*lanosa*	96	25	80	f	ec
Ruwenzorisorex	*suncoides*	96	25	40	m	ec
Crocidura	*tansaniana*	96	25	60–70	m	e
Surdisorex	*norae*	97	26	30	m	e
Crocidura	*nigeriae*	98	26	60–70	f, s	w
VERY LARGE (mean HB: 100–149 mm)						
Crocidura	*turba*	100	n. d.	58	f, s	e, c
Crocidura	*flavescens*	100	26	49	s, m	s
Sylvisorex	*ollula*	103	n. d.	57	f	c
Crocidura	*foxi*	103	25	50–63	s	w
Crocidura	*zaphiri*	105	n. d.	57	?	e
Crocidura	*longipes*	105	25	60	s?	w
Crocidura	*telfordi*	105	26	65–85	m	e
Crocidura	*fulvastra*	110/90	23	60	s	e
Suncus	*murinus*	114	32	40	comm	e
Crocidura	*mutesae*	115	25	60–75	f	c
Crocidura	*grandiceps*	117	26	55–65	f	w
Crocidura	*zimmeri*	118	27	45	s?	c
Crocidura	*olivieri*	125	33	70–80	f, s	w, e, c
Scutisorex	*somereni*	137	33	63	f, m	c
EXTREMELY LARGE (mean HB: >150 mm)						
Crocidura	*goliath*	165	38	68	f	c

Shrews are typically small, fast-running, terrestrial or semi-fossorial insectivores with long pointed snouts, minute eyes, small ears, short limbs, long tails and short dense fur. The eyes are small, and most species have poor eyesight so prey are located largely by smell, touch and by random searching. African shrews range in size from the tiny *Suncus etruscus* and *S. infinitesimus* of about 2.0 g to the large, rat-sized *Crocidura olivieri*, *C. goliath* and *Scutisorex somereni*, which have mean weights of ca. 60 g. The limbs are unspecialized, with five digits on each limb. Shrews have a generalized quadrupedal locomotion and a plantigrade gait, running with the sole and heel of the foot touching the ground. Neither the thumb nor big toe is opposable, so items such as food cannot be grasped freely by the hand. The radius and ulna are separate but the tibia and fibula are fused near the ankle. Like all soricomorphs, shrews possess clavicles. Members of the Soricidae have primitive brains and depend more on olfaction than on vision: the olfactory bulbs are very large but the eyes and optic foramina are small, and visual acuity is poor. Unlike most other eutherian mammals, the cerebral hemispheres are

smooth and with little convolution, and they usually do not extend backwards to cover the cerebellum or corpora quadrigemina. The neopallium and corpus callosum are very small. In outline, the skull is low and flat, and often long and slender. The braincase is small, the orbits open laterally, auditory bullae are absent, and zygomatic arches are absent or much reduced.

The first set of teeth of shrews is deciduous and is shed before birth. All the teeth are rooted. Unlike rodents, the incisors do not grow throughout life and they wear down as the animal ages. In the soricine shrews, the tips of the teeth are reddish in colour resulting from the deposition of iron in the outer enamel, a condition that is thought to increase resistance to wear. The total number of teeth in extant species of shrews varies between 28 and 32. Shrews normally have six teeth on each side of the lower jaw but a variable number in the upper jaw. The anterior dentition is specialized by the enlargement of the first upper incisor, which is large and hooked, and bears a notch and a cusp. The first lower incisor is also enlarged and is procumbent. Together these teeth function as fine forceps for grasping small invertebrates. The first upper incisor is followed by several small, unicuspid teeth (I^2, I^3, C, P^1, P^2, P^3), all rather similar in form; the number varies according to the genus, but in some genera there are only three unicuspid teeth (I^2, I^3, C; also referred to as U^1, U^2 and U^3). The remaining premolars and molars (P^4, M^1, M^2 and M^3) are large and possess sharp, high-pointed cusps, which can crush the tough, chitinous exoskeletons of invertebrate prey (Figure 9).

The genital and urinary systems of shrews have a common exit through a cloaca. The sexes are difficult to distinguish externally, particularly in immature individuals. The penis is usually retracted into the abdomen when not in use and, in immature ♂♂, is small and poorly developed. The testes are abdominal and do not descend into a scrotal sac, even when the ♂♂ are mature. However, breeding ♂♂ can be distinguished by the swollen testes on either side of the anus. In breeding ♀♀ the nipples are easily seen. In immature ♀♀ of many species, a small dark patch of fur marks the position of each nipple.

Shrews can be found in most terrestrial habitats, including forest, scrub and grassland, and at a wide range of altitudes. Some are fossorial (e.g. *Scutisorex*) and some (e.g. *Ruwenzorisorex)* are semi-aquatic. Shrews are most abundant in moist, well-vegetated habitats but a few are well adapted for life in xeric habitats. Some inhabit montane areas, for example *Crocidura montis* occurs in the afroalpine zone on Mt Elgon, Uganda at altitudes of 3300–4200 m. Many are commonly found in man-made habitats, especially in plantations and cultivated areas. Several are commensal with humans, and frequent gardens, shambas, houses and outbuildings, e.g. *Crocidura russula*, *C. olivieri* and *Suncus murinus*.

Many are proficient burrowers, and most can climb and swim well. The small size of shrews permits them to exploit a variety of habitats and penetrate narrow spaces, cracks and crevices in search of food and suitable nest sites. Many may utilize the tunnels of other small mammals for shelter and foraging. They frequent dense vegetation and find shelter

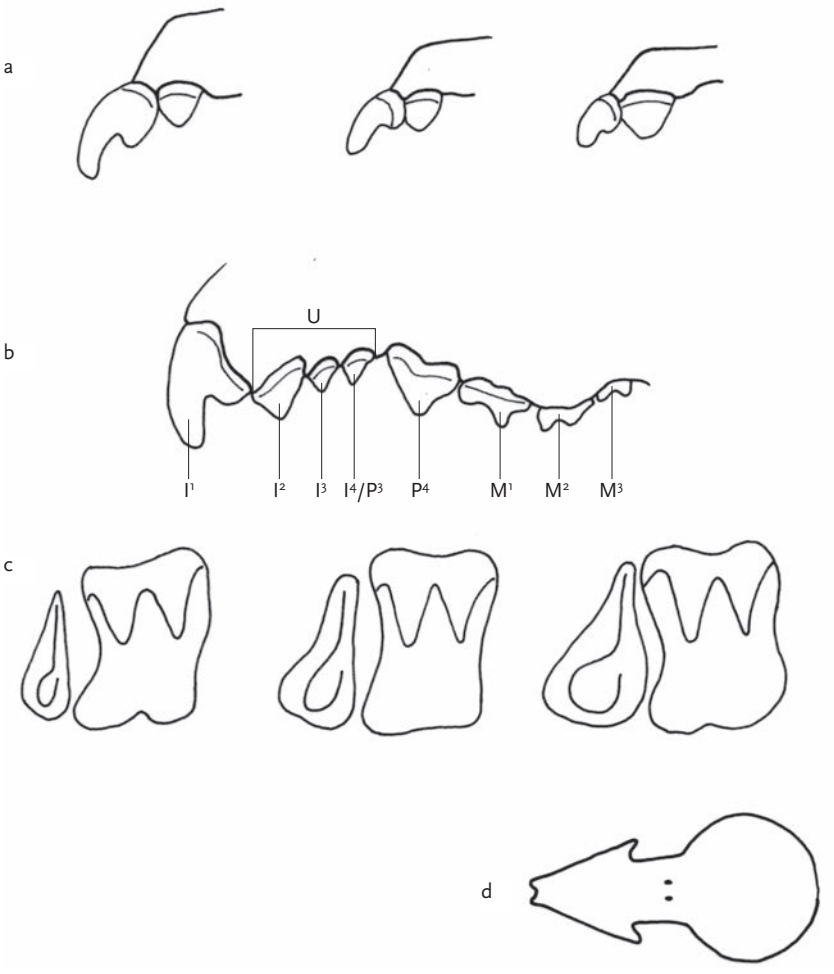


Figure 9. Some skull characteristics of shrews. (a) Size of upper I^1 relative to upper I^2: long and hooked (*left*), medium-sized and hooked (*centre*) and small and slightly hooked (*right*). (b) Upper left toothrow to show terminology: I = incisor, P = premolar, M = molar, U = unicuspid. (c) Right upper M^2 and upper M^3 (occlusal view) to show relative size of upper M^3 to upper M^2: small (*left*), medium (*centre*), large (*right*). Labial (outer side) pointing upwards. (d) Dorsal view of skull to show position of vascular foramina in the genera *Myosorex, Surdisorex* and *Congosorex.*

under logs, among rocks, beneath the roots of trees and under piles of dry brush and grass, and hence are rarely seen. Even the larger forms can remain unseen in dense forest with thick undergrowth.

Shrews feed on a variety of invertebrates. The principal prey of most species is arthropods (primarily insects), molluscs and earthworms. But they are highly opportunistic and larger species will also prey upon fish, amphibians and small reptiles. They may augment the diet with carrion and many consume some plant material, particularly seeds. No African shrews have been found to possess venomous saliva. Shrews have a reputation for voracious appetites and little resistance to starvation, needing to feed frequently day and night in order to survive. They have average daily energy expenditures significantly greater than those of rodents of similar size, and their basal metabolic rates are well above those predicted on the basis of size and weight. Soricine shrews have particularly high metabolic rates and energy requirements. Crocidurine shrews have lower metabolic rates and smaller food requirements. *Sorex araneus* (a non-African species) of about 9 g body mass requires 90% of its body weight in food or 9.7 kJ/g/day whereas *Crocidura russula* of similar size requires only 48% of its body weight or 3.4 kJ/g/day (Genoud 1985, Churchfield 1990). The large food requirements of these mammals are attributed to the high water content and indigestible chitin content of prey, as well as high metabolic rate. With their high metabolic rates, small body size and inability to store large quantities of fat as a food reserve, shrews are incapable of hibernating or entering extended torpor during critical periods of stress due to cold, heat, drought or food shortage. However, many crocidurine shrews exhibit short, daily periods of torpor with hypothermia. The African species *C. russula* can be induced to enter daily torpor by decreasing the availability of its food, during which the metabolic rate and body temperature are reduced (Genoud 1985).

It is common for several species of shrew to be syntopic as well as sympatric. It is not unusual for five or more species to coexist in the same habitat. In the forests of West and central Africa between eight and 16 syntopic species of shrews have been found (Dieterlen & Heim de Balsac 1979, Ray & Hutterer 1995, Churchfield *et al.* 2004, Dudu *et al.* 2005). In multi-species communities of shrews there is evidence of resource partitioning on the basis of body size: very small species are primarily epigeal foragers on small invertebrates active on the ground surface whereas large species are hypogeal foragers, subsisting mostly on larger, soil-dwelling prey (Churchfield *et al.* 1999, Dudu *et al.* 2005).

Shrews generally have poor vision, and they rely on tactile, auditory and olfactory senses for navigation and orientation around their home-ranges, for locating prey and for intra-specific communication. The sense of touch is well developed. The long flexible snout so characteristic of these mammals is well furnished with touch-sensitive vibrissae whose follicles are well supplied with nerve endings and which are useful in orientation and location of prey. Hearing is keen and shrews are able to produce and perceive a wide range of sounds, from squeaks and shrieks to grunts and snuffles, both in the audible range of human hearing and at ultrasonic frequencies. Shrews are highly vocal, particularly during social interactions and agonistic behaviour (Gould 1969). They emit high-pitched twitters as they explore and forage, and during interactions between the ♀♀ and her young. Young shrews produce staccato 'barks' to attract the mother's attention. Loud squeaks and rolling 'churls' are used by shrews when threatened or alarmed, and in aggressive meetings between individuals. Scent forms an important means of intra-specific communication, being used to indicate gender and reproductive condition and to delineate territories. Shrews have lateral flank glands situated mid-way between the fore- and hindlimbs. These are small, well-vascularized oval areas, which are present in both sexes but which are best developed in sexually mature ♂♂. They exude a greasy secretion that rubs off on vegetation as they pass by. Shrews frequently defecate in prominent places, suggesting another means of scent-marking. The musk shrews, *Crocidura* spp., are particularly odoriferous, exuding a sweet, musky scent. Females, and especially ♂♂, of *C. flavescens* actively scent-mark by rubbing the lateral glands against objects (Baxter & Meester 1982). Crocidurine shrews also possess anal or caudal glands at the base of the tail, and chin/neck glands, that are used for scent-marking. In *C. flavescens* scent-marking is very evident after aggressive encounters.

Most shrews are solitary and intolerant of conspecifics. There is evidence of territoriality in crocidurine and soricine shrews. They generally occupy individual territories that are largely mutually exclusive, although during the breeding season the territory or home-range of the ♂ is extended to overlap those of several ♀♀ (Churchfield 1990). Meetings between conspecifics, when they occur, are aggressive affairs: shrews squeak loudly, bite and wrestle with each other. Some species are more social: crocidurine shrews such as *C. hirta* and *C. russula* are aggressive towards strangers but will share nests with familiars (Meester 1963, Cantoni & Vogel 1989). Territoriality and sociability may vary seasonally. In winter, the home-ranges of individuals of *C. russula* overlap extensively, but there is strict territoriality between ♂♂ and between ♀♀ in summer and the formation of monogamous breeding pairs, which share nests (Cantoni & Vogel 1989). Home-ranges or territories range greatly in size between species, e.g. 75–395 m^2 in *Crocidura russula* and 400–2800 m^2 in (non-African) *Sorex araneus* (Genoud 1978, Churchfield 1990).

Many crocidurine and myosoricine shrews are capable of breeding whenever conditions are favourable, but most African species breed mostly during warm, wet months and reproduction declines in the dry season (Dieterlen & Heim de Balsac 1979, Rowe-Rowe & Meester 1985b). The breeding season of *Myosorex* shrews in southern Africa coincides with the onset of the rains but is also influenced by temperature; those at higher altitudes commence breeding later than those at lower altitudes (Rowe-Rowe & Meester 1985b, Baxter 2005). Shrews normally produce 2–3 litters during a breeding season. They have a postpartum oestrus allowing litters to be produced in quick succession when conditions are favourable. Gestation varies from about 24 to 33 days, according to species. Litter-size is generally large but it varies between species; crocidurine shrews have smaller litter-sizes (usually 3–4 young/litter) than soricines (5–7 young/litter). Young shrews are born naked and hairless but growth is rapid and within a few days the pelage is evident. In *Crocidura* and *Myosorex*, the eyes are open between Day 12 and 18 and they take their first invertebrate prey at around Day 19. Weaning occurs at about three weeks of age. Caravanning behaviour has been observed in some species, notably crocidurine shrews such as *C. bicolor*, *C. russula* and *Suncus etruscus*; when the young first leave the nest, the mother leads them along in a line, each young grasping the base of the tail of the

one in front (Ansell 1964, Fons 1974, Churchfield 1990). In tropical species there is rapid growth to sexual maturity, e.g. crocidurine shrews can mature and commence breeding within a couple of months of birth. Paternal care is rare amongst shrews, and the presence of the ♂ is usually not tolerated by the ♀. However, in some crocidurine shrews (e.g. *C. russula* and *Suncus varilla*) monogamous breeding pairs are formed, and the ♂ stays in attendance and may help to shelter the young (Cantoni & Vogel 1989, Lynch 1990, 1991).

Shrews undergo seasonal cycles in abundance. These are particularly well-documented in species in temperate regions where many mark–recapture studies have been carried out. Numbers are high in the temperate summer when breeding occurs but decline through autumn and into winter as young disperse and old adults die after breeding is completed. Similar trends in population dynamics have been found in *Myosorex* spp. in southern Africa (Rowe-Rowe & Meester 1985b). In contrast, there is little information about population dynamics of African shrews in the tropics. Population densities vary greatly according to species and habitat and to the alternation of dry and wet seasons. Population densities of African shrews appear to be much lower than those of temperate species. For example, reported densities of *Suncus varilla* in southern Africa are 0.25–8.0/ha (Lynch 1990, 1991) while those of *Crocidura suaveolens* and *Sorex araneus* in Europe vary from 12–100/ha (Genoud 1978, Churchfield 1990).

Longevity varies largely according to size. Shrews are amongst the shortest-lived mammals. Life-span of wild-living *Myosorex varius* in southern Africa is about 12–17 months (Rowe-Rowe & Meester 1985b), very similar to that of soricine shrews (Churchfield *et al.* 1995). *Suncus varilla* can survive for 24–30 months (Lynch 1990, 1991). Although small crocidurine shrews such as *Crocidura russula* can live up to 4 years in captivity, few survive longer than 1.5 years in the wild (Vogel 1972, Jeanmaire-Besançon 1986). Mortality is highest in young animals as they disperse after weaning. Some 30–50% of soricine shrews die or disperse during the first two months of life and only 20–40% of the original cohort survive to breed (Churchfield *et al.* 1995).

The fossil record of shrews in Africa is fragmentary. The earliest known fossils (*Latetium* sp.) are from the mid-Miocene of Morocco (ca. 14 mya) and from the late-Miocene of Tunisia (ca. 12 mya) (Butler 1998). More recent fossils, from the Pliocene (ca. 2.5–3 mya) and Pleistocene (ca. 0.5 mya) are more widespread in distribution and have been found in NW Africa (Morocco, Algeria and Tunisia), East Africa (Omo and Hadar in Ethiopia, Kobi Fora, Rusinga and Isenya in Kenya, Olduvai and Laetoli in Tanzania), and in Zimbabwe and South Africa. Fossil shrews have not been found in the Sahara, West and central Africa. The fossil record suggests that shrews probably entered Africa from south-west Asia in the early Miocene when a land bridge connected south-west Asia with Arabia (and hence Africa). Additionally, and at a later date, some shrews entered North-West Africa from the western Mediterranean. *Myosorex* and *Sylvisorex* are known from the middle–late Miocene.

Crocidura (now the most speciose of the genera of African shrews) seems to have originated in Africa, although it is now widespread in Eurasia. Radiation of this genus seems to have started in Africa at the end of the Miocene (Butler 1998). The origins of other genera are less well known. Both morphological and molecular investigations indicate rapid radiation of *Crocidura* in Africa (Butler 1998, Quérouil *et al.* 2005) with rapid morphological divergence occurring in response to palaeo-environmental changes. The expansion of forested habitats during warm moist periods and their contraction in cool dry periods, during the Pleistocene and Holocene promoted the speciation of shrews, especially *Crocidura* spp., and allowed some to adapt to arid and semi-desert environments. In localities where the fossil record is good, several species may be distinguished; e.g. Butler & Greenwood (1979) recognized nine species from mandibular fragments (*Sylvisorex*, *Suncus* and *Crocidura* spp.) at Olduvai in Tanzania – a rich community similar to communities of shrews in some forested habitats today. Good reviews of fossil shrews are given by Heim de Balsac & Lamotte (1956, 1957) and Butler (1998) (and references therein).

Recent molecular findings (with rRNA sequencing) support evidence from external, cranial and dental characters that, amongst the genera of African shrews, two major lineages have emerged (Meester 1953, Heim de Balsac & Lamotte 1956, 1957, Quérouil *et al.* 2001). The first includes *Myosorex* and *Congosorex* (supporting the existence of a myosoricine taxon) and the second includes the six remaining genera (*Crocidura*, *Paracrocidura*, *Ruwenzorisorex*, *Scutisorex*, *Suncus* and *Sylvisorex*). Although *Sylvisorex* appears to be polyphyletic, *Crocidura* is monophyletic and all species investigated, with representatives from India and Europe as well as Africa, seem to be closely related (Quérouil *et al.* 2001). Grouping patterns of species from different continents suggest that there have been multiple exchanges between Africa and Eurasia (Quérouil *et al.* 2001).

The genera, and species within each genus, are arranged alphabetically. In the Descriptions, an indication of the size of each species is recorded comparatively to other species in the family. The size categories (see also Table 8) based on head and body length (HB), are:

minute: less than 49 mm; very small: 50–59 mm; small: 60–69 mm; small–medium: 70–79 mm; medium: 80–89 mm; large: 90–99 mm; very large: 100–149 mm; extremely large: more than 150 mm.

The size categories of tail length as a percentage of head and body (see also Table 8) are: short: <40%; medium: 41–60%; long: 61–80%; very long: 81–100%; extremely long >101%.

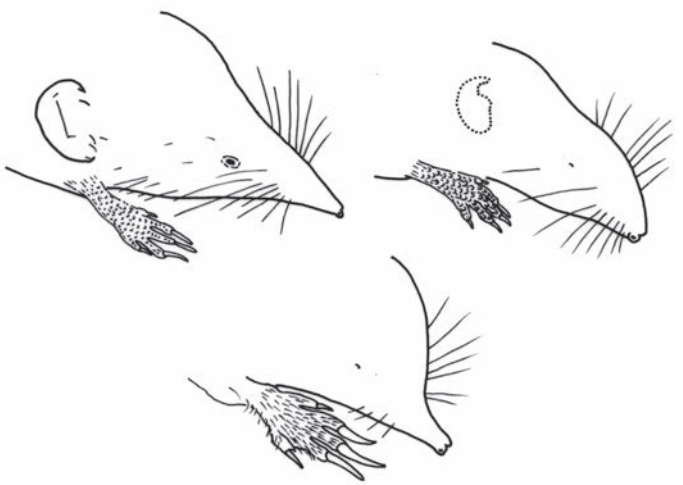


Figure 10. Head and right forefoot of *Myosorex* (*upper left*), *Congosorex* (*upper right*) and *Surdisorex* (*bottom*) to show variation in shape of head, size of eye, shape of forefoot and length of claws (after Hutterer *et al.* 2001).

Shrews are not easy to identify. The most important characteristics are size and mass (Table 8), pilosity of the tail (Figure 11), and the fine details of the skull and teeth. Within Africa, the geographical distribution and habitat may help to narrow the number of possibilities for a correct identification. Because of the large numbers of species of shrews in Africa, and because the geographic distributions of many species overlap, it is not possible to provide full details of similar species in the species profiles. For *Crocidura*, the section on 'Similar Species' is omitted and for the other genera, 'Similar Species' is restricted to other species in the genus (see also Tables 7 and 8 for comparisons between genera and species).

Sara Churchfield

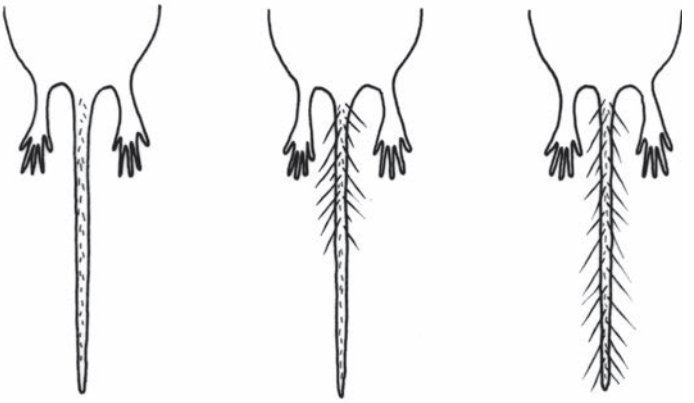


Figure 11. Pilosity of the tails of shrews: 0% (*left*), 50% (*centre*), 100% (*right*).

GENUS *Congosorex*
Congo Shrews

Congosorex Heim de Balsac and Lamotte, 1956. Mammalia 20: 167. Type species: *Myosorex polli* Heim de Balsac and Lamotte, 1956.

Congosorex polli.

The genus contains three species: two (*C. polli*, *C. verheyeni*) live in primary and secondary lowland rainforest, gallery forest and small savanna patches within the forest of the Congo Basin, and the third species (*C. phillipsorum*) lives in isolated montane forest, bamboo, or marshy habitats in the Eastern Arc Mts of SW Tanzania above 1500 m.

Congosorex was described as a subgenus of *Myosorex* (Heim de Balsac & Lamotte 1956), and treated as a full genus by Heim de Balsac (1967) and subsequent authors (Hutterer 1993, 2005b, Stanley *et al.* 2005a). The original description compared *Congosorex* with *Myosorex (sensu stricto)* and *Surdisorex*. The full variability and species composition of the genus is not yet known.

The characters of *Congosorex* are somewhat cryptic. Species of the genus resemble species of *Myosorex* externally, but limbs and tail in *Congosorex* are generally shorter (tail length 30–58% of HB, cf. 42–84% in *Myosorex*). Other characteristics of the genus are short dense pelage (long and dense in *Myosorex* and *Surdisorex*), large head relative to rest of body, moderate or large-sized ears (normal or reduced in *Myosorex*, atrophied in *Surdisorex*), moderate-sized forefeet and claws (large in *Myosorex*, very large in *Surdisorex*) (Heim de Balsac & Lamotte 1956), prominent scales on fore- and hindfeet, absence of long hairs on the tail (as in *Myosorex* and *Surdisorex*) and minute eyes (Hutterer *et al.* 2001). On the skull, braincase is wide and rostrum is short (giving a broader-looking skull than in other genera of African shrews), there are three upper unicuspids, fourth upper unicuspid

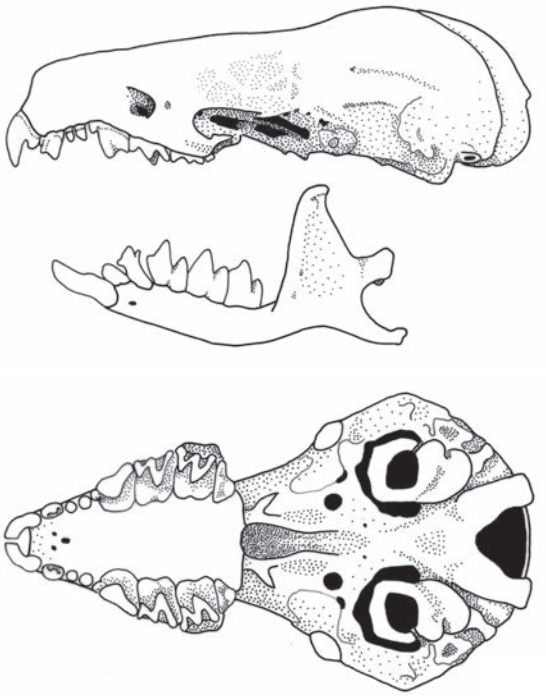


Figure 12. Skull and mandible of *Congosorex verheyeni* (ZFMK 99.932 [holotype]).

(P^3) is absent (present in *Myosorex*, absent in *Surdisorex*) and M^3 is large. Dental formula: $I\,^3/_2$, $C\,^1/_0$, $P\,^1/_1$, $M\,^3/_3 = 28$ (Figure 12). The tip of the phallus of male *Congosorex* is pointed, in contrast to the rounded condition found in *Myosorex* (Stanley *et al.* 2005a). Two vascular foramina are present between the parietal bones of the cranium, as in *Myosorex* and *Surdisorex* (see also Table 7).

The biology of any of the species is hardly known. Most specimens were collected in primary rainforest and, less frequently,

in secondary rainforest. The reduction of the limbs, tail and ear may indicate that foraging occurs in leaf litter or under logs, mosses or other cover.

Genetic data show that *Congosorex* is a sister taxon of *Myosorex*, and that both are members of the subfamily Myosoricinae (or tribe Myosoricini), which comprises *Myosorex*, *Congosorex* and probably *Surdisorex*, and is the most ancient taxon of all living African shrews (Quérouil *et al.* 2001, Hutterer *et al.* 2002).

The species are distinguished by tail and hindfoot length, and distribution.

Rainer Hutterer & William T. Stanley

Congosorex phillipsorum Phillips's Congo Shrew

Fr. Musaraigne de Phillips; Ger. Phillips Kongo-Spitzmaus

Congosorex phillipsorum Stanley, Rogers and Hutterer 2005. J. Zool., Lond. 265: 271. Ndundulu Forest, Udzungwa Mountains, Tanzania.

Taxonomy A member of the Myosoricini with some characters shared with *Myosorex*. Synonyms: none. Chromosome number: not known.

Description Small–medium robust shrew with dark brown pelage and relatively large head. Dorsal pelage dark brown; hairs slate-grey, dark brown at tip. Hairs 5 mm (dorsal), 3 mm (ventral). Ventral pelage only slightly paler than dorsal pelage; hairs brown at tip. Head large relative to body (measuring about one-third of HB length). Vibrissae long (10–14 mm), thin, translucent. Ears barely visible, covered with long hairs. Fore- and hindfeet covered in dark conspicuous scales. Tail relatively medium long (55–60% of HB), only slightly bicoloured. Male phallus pointed. Nipples: not known.

Geographic Variation None recorded.

Similar Species

Congosorex polli. Smaller (HB: 60 mm, n = 1), tail shorter (T: 24 mm, n = 1). DR Congo.

Congosorex verheyeni. On average smaller (HB: 59 [53–95] mm; tail shorter T: 20 [19–26] mm). Congo and Central African Republic.

Distribution Endemic to Africa. Afromontane–Afroalpine BZ of Tanzania. Known only from the Ndundulu and Nyumbanitu forests of the Udzungwa Mts, Tanzania.

Habitat Undisturbed or slightly disturbed montane forests above 1500 m in Ndundulu and Nyumbanitu forests of the Udzungwa Mts where soil is moist; occasionally found in bamboo forests and marshy habitats (Stanley *et al.* 2005a). Known altitudinal range 1500–2086 m.

Abundance In one survey in Ndundulu Forest, Udzungwa Mts, comprised 53% of all shrews (4 spp., including *Myosorex kihaulei*, *Crocidura hildegardeae* and *C. monax*).

Remarks Terrestrial and predominantly nocturnal. A sample of nine individuals (collected in July 2003) consisted of six ♂♂ and three ♀♀. The two ♀♀ examined were not pregnant. Testes length of four ♂♂ examined ranged from 5–7 mm (mean = 5.7); width 2.5–4 mm (mean = 3.4), with 50% of the sample exhibiting convoluted epididymes.

Congosorex phillipsorum

Conservation IUCN Category: Critically Endangered.

Threatened because of fragmented distribution and decline in suitable habitat.

Measurements

Congosorex phillipsorum

HB: 71.3 (68–76) mm, n = 9
T: 37.1 (35–40) mm, n = 9
HF: 12.7 (12–14) mm, n = 9
E: 7.4 (7–8) mm, n = 9
WT: 7.9 (7.4–8.3) g, n = 9
CI: 19.2 (18.8–20.0) mm, n = 17
GWS: 10.7 (10.2–10.9) mm, n = 20
I^1–M^3: 8.2 (7.7–8.7) mm, n = 20
Ndundulu Forest, Udzungwa Mts, Tanzania (Stanley *et al.* 2005a)

Key Reference Stanley *et al.* 2005a.

William T. Stanley

Congosorex polli Greater Congo Shrew

Fr. Musaraigne du Congo; Ger. Grosse Kongo-Spitzmaus

Congosorex polli (Heim de Balsac and Lamotte, 1956). Mammalia 20: 155.
Lubondai via Tshimbulu (06° 30' N, 22° 39' E), Kasai Province, DR Congo.

Taxonomy Originally described in the genus *Myosorex*. Type species of the genus *Congosorex* (as defined by Heim de Balsac & Lamotte 1956, Hutterer *et al.* 2002); a sister taxon of *Myosorex* (Quérouil *et al.* 2001) and probably also of *Surdisorex*. Synonyms: none. Chromosome number: not known.

Description Small shrew. Dorsal and ventral pelage brown, body hairs short. Head large compared to the rest of the body. Ear reduced but larger than in *C. verheyeni*. Eyes small and hidden by pelage. Forefeet short with moderately developed digits and claws; scales large, covering the dorsal surface of the forefeet. Hindfoot also short with short claws and large scales. Tail relatively short (ca. 40% of HB), covered with short hairs over its entire length; no longer hairs present. Skull with a short rostrum, narrow maxillary, wide interorbit and a wide and inflated braincase. Nipples: not known. See also genus profile.

Geographic Variation None recorded.

Similar Species

Congosorex phillipsorum. Larger (HB: 68–76 mm). Tail longer (T: 35–40 mm). Udzungwa Mts, Tanzania.

Congosorex verheyeni. Skull perhaps shorter (CI: 17.8–19.1 mm). Congo and Central African Republic.

Distribution Endemic to Africa. Southern Rainforest–Savanna Mosaic. Known only from the type locality in Kasai Province, DR Congo.

Habitat Not recorded; probably gallery forest in the savanna.

Abundance No information; one of the rarest African shrews.

Remarks Like *Congosorex verheyeni*, *C. polli* has short limbs and reduced eyes and ears, which may indicate a secretive life under litter, logs or below ground.

Conservation IUCN Category: Data Deficient.
Known only by a single specimen collected in 1955.

Congosorex polli

Measurements

Congosorex polli
HB: 60 mm, n = 1
T: 24 mm, n = 1
HF: 10 mm, n = 1
E: 6.5 mm, n = 1
WT: n. d.
CI: 20.3 mm, n = 1
GWS: 10.4 mm, n = 1
I^1–M^3: 8.7 mm, n = 1
Kasai Province, DR Congo (Hutterer *et al.* 2002)

Key References Heim de Balsac & Lamotte 1956; Hutterer *et al.* 2002.

Rainer Hutterer

Congosorex verheyeni Lesser Congo Shrew

Fr. Musaraigne petite du Congo; Ger. Kleine Kongo-Spitzmaus

Congosorex verheyeni Hutterer, Barrière and Colyn 2001. Bull. Inst. Roy. Sci. Nat. Belgique, Biol. 71 (suppl.): 7–16. Mbomo (00° 24' N, 14° 44' E), Parc National d'Odzala, Congo.

Taxonomy Synonyms: none. Chromosome number: not known.

Description Very small, stout shrew with a very short tail. Dorsal and ventral pelage dark brown. Body hairs short: 5 mm (dorsum), 3 mm (ventrum). Head comparatively large, distance from tip of nose to back of ear about one-third of head and body length. Nose and lips flesh-coloured. Vibrissae sparse, longest 12 mm. Ear present, reduced in size and covered by hairs. Eye opening minute, hidden by pelage. Forefeet short with moderately developed digits and claws; large scales cover dorsal surface of forefoot. Hindfoot also short with short claws and large scales. Tail very short (ca. 32% of HB), with 11 short and weak caudal vertebrae; pale-coloured, covered with short, black hairs over entire length. Nipples: 0 + 2 = 4.

Geographic Variation None recorded.

Similar Species

Congosorex phillipsorum. On average larger (HB: 71.3 [68–76] mm); tail longer (T: 35–40 mm). Udzungwa Mts, Tanzania.

Congosorex polli. Skull perhaps longer (CI: 20.3 mm, n = 1). DR Congo.

Distribution Endemic to Africa. Rainforest BZ (Gabon subregion) and adjacent Rainforest–Savanna Mosaic. Known from three localities in Odzala National Park, Congo, and four localities in Ngotto forest, Central African Republic. All localities are on the right (northern) bank of the Congo R.

Habitat Primary and secondary lowland rainforest. One specimen was collected in adjacent savanna and a few others in newly regenerated forest patches (Barrière *et al.* 2000).

Abundance Only 53 specimens have been collected at the present time. Never a dominant species of the community of shrews but may be locally common. In Odzala N. P. comprised only 1% of shrews (n = 255) in primary forest, and 3% (n = 142) in disturbed forest (Barrière 1997). In Ngotto N. P., comprised 2% of shrews in Batouri (primary forest, n = 1350, 18 spp.); 4% in Bambio (secondary forest, n = 27, 7 spp.); 8% in Grima (secondary forest, n = 63, 10 spp.); and 9% in Massangaï (secondary forest, n = 66, 8 spp.) (Barrière *et al.* 2000).

Remarks Short limbs, reduced eyes and ears may indicate adaptations to a secretive life under litter, logs or below ground. May feed preferentially on subterrestrial invertebrates such as earthworms. Embryo number: 2 (n = 1; Ngotto forest; wet season; P. Barrière, unpubl.).

Congosorex verheyeni

Conservation IUCN Category: Least Concern.

Occurs in two National Parks in Congo and in Central African Republic.

Measurements

Congosorex verheyeni

HB: 59 (53–95) mm, n = 15

T: 20 (19–26) mm, n = 15

HF: 9 (9–11) mm, n = 15

E: 6 (4–8) mm, n = 12

WT: 7.1 (4–12) g, n = 14

CI: 18.4 (17.8–19.1) mm, n = 10*

GWS: 10.0 (9.7–10.3) mm, n = 10*

I^1–M^3: 8.1 (7.7–8.4) mm, n = 11*

Odzala National Park, Congo and Ngotto National Park, Central African Republic (Hutterer *et al.* 2001)

*Stanley *et al.* 2005a

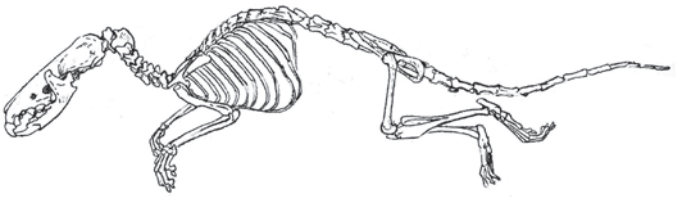
Key References Barrière *et al.* 2000; Hutterer *et al.* 2001; Quérouil *et al.* 2001.

Patrick Barrière & Rainer Hutterer

GENUS *Crocidura*
Shrews (White-toothed Shrews)

Crocidura Wagler, 1832. Isis, p. 275. Type species: *Sorex leucodon* Herman, 1780.

Crocidura flavescens.



Skeleton of *Crocidura* sp.

The genus *Crocidura* contains more species than any other genus of African mammals (see below), and is found throughout the whole continent and in every biotic zone. Because of the widespread geographic range of the genus, one or more species of the genus is found in almost every habitat except in the driest of deserts.

The characters of the genus include rather small size and slender build. Head and body ranges (according to species) from very small (*C. bottegoides*; HB: ca. 50 mm, HF: 10 mm, WT: 3 g) to large (*C. olivieri*; HB: up to 140 mm, HF: ca. 23 mm, WT: 65 g). The largest species (*C. goliath*, *C. olivieri*) are equivalent in size to a medium-sized murid rodent. Pelage colour is usually undistinguished – drab brown or grey, often paler on the ventral pelage, and without any special markings or colours. The head is pointed (more so than in other genera of shrews), with a long muzzle, which projects anteriorly beyond the nasal bones of the skull and, in life, is constantly wiggled from side to side (see below, and order profile). The rhinarium is simple, divided into two by a vertical slit between the two nostrils. Eyes are small but visible, and ears are small and rounded (slightly more prominent than in *Myosorex*) with a complex arrangement of folds on the inner surface. The fore- and hindfeet are short and simple, without hairs on the outer side of the hindfeet; forefeet have five digits, hindfeet have five digits, all with small claws. The tail is usually thicker towards the base, tapering to the tip, and (in most species) covered with small bristles and scattered long (usually) pale hairs. These long hairs are almost unique to this genus of shrews (also present, to a lesser extent, in *Suncus* and *Paracrocidura*) and are useful for species identification. The proportion of the tail covered with these long hairs is expressed as the 'pilosity' of the tail (Fig. 27); pilosity is the percentage of tail, measured from the base, which supports these long hairs (e.g. 0% [no long hairs], 50% [basal half of tail]; 75% [basal three-quarters of tail] and 100% [all of tail]). In external characteristics (except for size), *Crocidura* shrews show great morphological similarity and hence are very difficult to distinguish. The skull is elongated and low, without zygomatic arches (as in all shrews), the teeth are white (not pigmented). Dental formula: $I\ ^{3}/_{1}$, $C\ ^{1}/_{1}$, $P\ ^{1}/_{1}$, $M\ ^{3}/_{3} = 28$. All teeth are cuspidate, a typical condition in shrews and other insectivores. I^1 is long and hooked with two denticulations (cusps), the anterior one being larger than the posterior one, and is followed posteriorly by three uniscuspid teeth (U^1, U^2, U^3) – not four as in most other genera of shrews (see Table 7), which are morphologically I^2, I^3 and C (Hutterer 2005c). The unicuspid teeth are small; they usually vary in size, the smallest being the most posterior. There is only one premolar; this is P^4 (P^1, P^2 and P^3 are lost) and is usually the largest tooth in the molar row. The premolar is followed by three molars; M^1 and M^2 are similar in size to P^4, and like P^4 have a complicated W-shaped pattern of cusps and ridges. M^3 is much smaller and variable in size, with a simple cusp. The widest point of the skull is across the braincase. The mandible is elongated with only six teeth in each ramus; I_1 does not have denticulations, the coronoid process is tall, vertical and rises well above the mandibular process, and the angular process is elongated and usually the most posterior part of the mandible (Figure 13). Some species of *Crocidura* shrews have a very strong pungent odour, produced by numerous secretory glands in the skin and tail. See Table 7 for comparisons with other genera of shrews.

The number of extant species in the genus is uncertain, and has varied according to the authority and the methods of study. Dollman (1915a, b, c, d, e, f, 1916) recorded 126 species (plus five indeterminate) in Africa, and Hutterer (2005b) recognized 171 species worldwide, of which 106 (62%) are African. Here, 105 species of *Crocidura* are recognized and described; many other previously described taxa are now regarded as synonyms. *Crocidura* is also the most speciose of the nine genera of African shrews, comprising 70% of the 150 of the currently recognized species of African shrews.

Crocidura shrews are terrestrial, although a few species are scansorial. None are fossorial (cf. *Surdisorex*) or semi-aquatic (cf. *Ruwenzorisorex*). Little is known about the ecology of *Crocidura* shrews in Africa. Like other shrews, all are insectivorous, consuming a high proportion of their body weight in a 24-hour period. Species that have been studied feed on a wide variety of insects and other invertebrates (Churchfield *et al.* 2004). It is evident that many species of *Crocidura* (together with species from other shrew genera) can live syntopically, implying that there must be important mechanisms for avoiding competition. Studies in Gabon have recorded five species of *Crocidura* (plus up to four other species belonging to different genera) in the same study area (Nicolas *et al.* 2003).

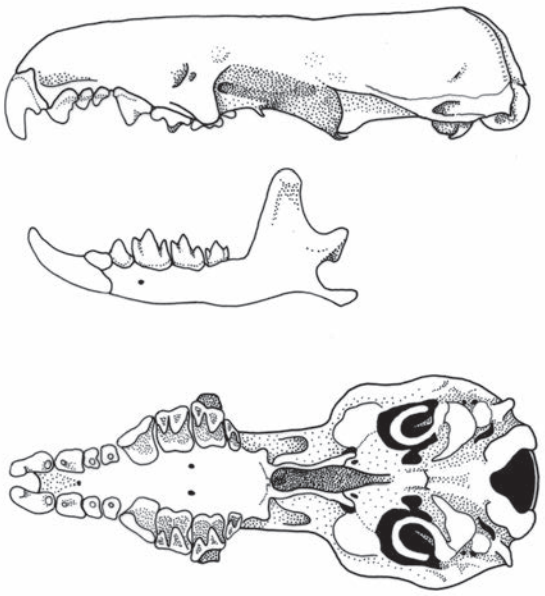


Figure 13. Skull and mandible of *Crocidura olivieri* (HC 579).

Crocidura shrews rely on their olfactory senses rather than visual senses for communication and foraging. They have scent glands on many parts of the body, which determine social relationships. The eyes of *Crocidura* shrews are small (size varying by species) and are thought to be of limited value other than providing a general impression of light intensity. Shrews make a variety of vocalizations (see e.g. *C. flavescens*, *C. hirta* and order profile), which indicate specific emotions. *Crocidura* shrews are mostly solitary, except during mating and care of the young; the best known of social behaviours is caravanning of the young in some species (e.g. *C. hirta*, *C. fuscomurina* and *C. russula* among African species). The small size of *Crocidura* shrews (and other shrews) means thermoregulation is an important aspect of metabolism; very little is known about these topics for African species, although it is well known that individuals of *Crocidura* shrews are often torpid if kept in cool conditions, particularly if food is unavailable.

The systematics of *Crocidura* is difficult because of the similarity between species. Dollman (1915a *et seq.*) divided the genus into 22 groups on the basis of size, pelage colour, length of hairs, relative size and width of the second and third unicuspid teeth, size of M^3, and pilosity of the tail – characters that are still considered to be useful at the present time. Heim de Balsac (in a series of papers) divided the African Crocidura into four groups: *dolichura* group (Brosset *et al.* 1965), *smithii* group (Heim de Balsac 1966), *flavescens* group (Heim de Balsac & Barloy 1966) and *bicolor* (*fuscomurina*) group (Heim de Balsac 1958).

Butler *et al.* (1989) studied the mandibles (a structure often found in owl pellets) and, using principal component analysis, sorted them into six groups (but with many outliers). Hutterer & Happold (1983) divided the 21 *Crocidura* shrews of Nigeria into seven groups on the basis of size, length of tail and habitat (forest or savanna). Karyological and molecular studies have not assisted, to any great extent, with the systematics of shrews; the chromosome number is known for some species (see e.g. Schlitter *et al.* 1999), but since most species have not been studied in this respect, such methods are, at the present time, of limited value for identification.

The genus is considered to be monophyletic (Quérouil *et al.* 2001). Within the African Soricidae as a whole, two lineages are apparent. One of these corresponds to the subfamily Crocidurinae, contains *Crocidura*, *Sylvisorex*, *Suncus*, *Scutisorex* and *Ruwenzorisorex* (and *Paracrocidura*) (see also family profile). The second lineage (subfamily Myosoricinae [see Hutterer 2005b]) contains *Congosorex* and *Myosorex*. (*Surdisorex* was not included in this study.) An alternative view by Butler *et al.* (1989) is that *Crocidura* is not a natural taxonomic unit, rather it is polyphyletic and includes several lineages. Studies on the chromosomes of *Crocidura* (Maddalena & Ruedi 1994), but with only a limited number of species, show that within the genus, three evolutionary trends are apparent. The first retains a karyotype close to the ancestral state and is represented by species throughout the worldwide geographic range (and includes the African *C. luna*, *C.* cf. *bottegi* and *C. bottegi*); the second exhibits an increase in both the number of chromosomes and the fundamental number (due to fission) and includes most of the African *Crocidura*; and the third shows a reduction of both the number of chromosomes

Crocidura maurisca.

and the fundamental number (due to Robertsonian fusions) and is typical of the Palaearctic–Oriental species. Thus the majority of African *Crocidura* form a single clade, strongly suggesting that there was rapid evolution of the genus within Africa (Butler *et al.* 1989, Quérouil *et al.* 2001, 2005).

The fossil record of the genus (and indeed all shrews) in Africa is limited (Butler 1978). Shrews are thought to have originated in Eurasia (see family profile) in the Oligocene. The radiation of *Crocidura* seems to have started at the end of the Miocene (Butler 1978, 1998) just after a period of major extinction when many ecological niches became vacant (Maglio 1978). There are fossil *Crocidura* from the late Pliocene (ca. 2 mya) of South Africa, and from the early Pleistocene (ca. 1.5 mya) of Tanzania (Butler 1978, 1998). Alternation of wet and dry periods during the Pleistocene undoubtedly assisted the amazingly successful adaptive radiation of *Crocidura* shrews.

The species of the genus are very difficult to identify on gross morphological characteristics. The following characters are helpful: body dimensions and weight, pilosity and relative length of tail, shape of skull, shape of I^1, relative size and shape of unicuspid teeth and M^3, habitat and distribution.

D. C. D. Happold

Crocidura aleksandrisi Cyrenaica Shrew

Fr. Crocidure de Libye; Ger. Cyrenien-Spitzmaus

Crocidura aleksandrisi Vesmanis, 1977. Bonn. Zool. Beitr. 28: 3. Cyrenaica, 5 km W Tocra, Libya (32° 31' N, 20° 34' E).

Taxonomy Looks like a small form of the European *C. suaveolens*. This species was referred to as *C. russula* by Ranck (1968). Synonyms: none. Chromosome number: 2n = 40 (P. Benda pers. comm.).

Description Small shrew. Pelage soft and short (hairs ca. 2 mm). Dorsal pelage greyish-brown, with slight tinge of russet; hairs dark grey at base, brown at tip. Ventral pelage grey to brownish-grey; hairs dark grey at base, grey to pale brown at tip. Colour of head similar to dorsal pelage. Chin, throat and chest grey. Fore- and hindfeet brown. Tail relatively long (ca. 70% of HB), brown above, slightly paler below; pilosity 90%. Skull unspecialized; rostrum and maxillary medium, interorbit wide, braincase width medium, and braincase height high. First upper incisor long and hooked, third molar wide (cf. Vesmanis 1977). Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Mediterranean Coastal BZ. Recorded from only a few localities in Cyrenaica, Libya (Hutterer 1993).

Habitat Wadis and bushland with Mediterranean-type vegetation in the northern part of Cyrenaica.

Abundance No information.

Remarks Remains of this shrew were abundant in pellets of Barn Owls collected in Wadi al Kuf, Cyrenaica (R. Hutterer, unpubl.).

Conservation IUCN Category: Least Concern.

Measurements

Crocidura aleksandrisi

HB: 60.2 (56–65) mm, n = 6
T: 43.2 (39–46) mm, n = 6

Crocidura aleksandrisi

HF: 11.8 (11–12) mm, n = 6
E: 7.8 (7.6–8.0) mm, n = 2
WT: 4.8 (4–6.5) g, n = 3
CI: 17.4 (16.6–18.1) mm, n = 4
GWS: 7.9 (7.7–8.2) mm, n = 3
I^1–M^3: 7.4 (6.8–8.0) mm, n = 57
Cyrenaica, Libya (Vesmanis 1977, R. Hutterer unpubl.)

Key Reference Vesmanis 1977.

Rainer Hutterer

Crocidura allex East African Highland Shrew

Fr. Crocidure des montagnes; Ger. Hochland-Spitzmaus

Crocidura allex Osgood, 1910. Field Mus. Nat. Hist. Publ., Zool. ser. 10 (3): 20. Kenya, 'Naivasha, British East Africa'.

Taxonomy Synonyms: *alpina*, *zinki* (see Heim de Balsac & Meester 1977). Subspecies: none. Gureev (1979) listed *alpina* as a distinct species without comment.

Description Small dark brown shrew. Pelage thick and dense, 3–4 mm dorsally. Dorsal pelage burnt umber, hairs dark grey, burnt umber at tip. Ventral pelage brownish-grey; hairs grey on basal half, brownish-grey on terminal half. Fore- and hindfeet dark brown, digits with sharp pointed claws. Tail relatively very long (ca. 82% of HB), dark brown, pilosity 40%. Rostrum short, maxillary width medium, and interorbital constriction wide. Braincase wide and of medium height. First incisor moderately long and hooked, third molar wide. Nipples: not known.

Geographic Variation Uncertain. Heim de Balsac (1957a) described a subspecies (*zinki*) from a high elevation (3550 m) on Mt Kilimanjaro, but this has not been recognized by subsequent authors.

Distribution Endemic to Africa. Afromontane–Afroalpine BZ. Recorded only from the highlands of C Kenya (e.g. Mt Kenya, Aberdare Ranges, Mau Forest, Nanyuki – see Aggundey & Schlitter 1986) and N Tanzania (Mt Kilimanjaro, Mt Meru and Ngorogoro Crater).

Habitat Occurs from the forest to the alpine zones (Grimshaw *et al.* 1997). On Mt Meru collected in the bamboo zone between 2550 and 2750 m (Demeter & Hutterer 1986). Recorded to at least 3700 m on Mt Kilimanjaro (Child 1965) and up to 4100 m on Mt Kenya (Coe & Foster 1972).

Abundance Rather common on Mt Kilimanjaro at 3500 m in habitats with highest ground cover (Shore & Garbett 1991). The second most abundant small mammal on the Shira Plateau (Mt Kilimanjaro), with densities of 2.9–5.8/ha (Shore & Garbett 1991). Not common on the montane grasslands of Mt Kilimanjaro (W. N. Verheyen pers. comm. 2003).

Remarks On Mt Kenya, found on pathways made by *Otomys* spp. (Otomyinae: Rodentia) (Coe & Foster 1972). One pregnant ♀ found on Mt Kilimanjaro (17 Jul–7 Aug; n = 23 shrews; Shore & Garbett 1991). Remains of *C. allex* were found in faeces of Servals *Leptailurus serval* in Ngorogoro Crater, Tanzania (Geertsema 1985). Raptors may also be predators.

Crocidura allex

Conservation IUCN Category: Vulnerable.

Measurements

Crocidura allex
HB: 60.7 (55–64) mm, n = 8
T: 49.5 (45–55) mm, n = 8
HF: 11.4 (10–12) mm, n = 8
E: 7.9 (7–9) mm, n = 7
WT: 5.2 (4–8) g, n = 9
CI: 17.3 (16.8–18.2) mm, n = 6
GWS: 7.7 (6.9–8.1) mm, n = 6
I^1–M^3: 7.1 (7.0–7.3) mm, n = 5
Mt Meru, Tanzania (Demeter & Hutterer 1986, R. Hutterer unpubl.)

Key References Child 1965; Shore & Garbett 1991.

Rainer Hutterer

Crocidura ansellorum Ansells's Shrew

Fr. Crocidure des Ansells; Ger. Ansells Spitzmaus

Crocidura ansellorum Hutterer and Dippenaar, 1987. Bonn. Zool. Beitr. 38: 1 (see also below).
Kasombu stream (= Isombu River), Mwinilunga Distr., Zambia. 4100 ft.

Taxonomy The species was originally named *C. anselli* but was emended to *C. ansellorum* (Hutterer & Dippenaar 1987b). The phylogenetic relations of the species are unknown. Synonyms: none. Chromosome number: not known.

Description Very small shrew. Pelage soft, hairs ca. 4 mm. Dorsal pelage dark chocolate-brown. Ventral pelage slightly washed with greyish-brown (most notable on the throat of the holotype). Limbs and ears dark chocolate-brown. Tail relatively long (ca. 80% of HB), greyish-brown; pilosity ca. 51%. Skull broad and high-domed. Upper incisor long and hooked. First unicuspid large and pointed, second and third subequal in size, all three with a well-developed cingulum. Third upper molar medium-sized. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Zambezian Woodland BZ. Recorded only from N Zambia; regarded as endemic to the Ikelenge Pedicle, NW Zambia (Cotterill 2002b).

Habitat Gallery forest along streams.

Abundance Rare; known from only three specimens.

Remarks Apparently no other information available.

Conservation IUCN Category: Endangered.

Measurements
Crocidura ansellorum
HB: 57.3 (56–58) mm, n = 3
T: 46.3 (41–51) mm, n = 3
HF: 11.2 (10.5–12) mm, n = 3

Crocidura ansellorum

E: 7.7 (7.5–8) mm, n = 2
WT: 4.6 (4.2–5) g, n = 2
CI: 17.4 (16.8–17.7) mm, n = 3
GWS: 8.2 (8.0–8.4) mm, n = 3
I^1–M^3: 7.4 (7.2–7.6) mm, n = 3
N Zambia (Hutterer & Dippenaar 1987a)

Key References Cotterill 2002b; Hutterer & Dippenaar 1987a.

Rainer Hutterer

Crocidura attila Hun Shrew (Cameroon Shrew)

Fr. Crocidure du Cameroun; Ger. Hunnen-Spitzmaus

Crocidura attila Dollman, 1915. Ann. Mag. Nat. Hist., ser. 8, 15: 512; ser. 8, 16: 141. Bitye, South Cameroon. 2000 ft.

Taxonomy Originally described as a subspecies of *C. poensis*; included in *C. buettikoferi* by Heim de Balsac & Meester (1977) but now considered to be a distinct species (Hutterer & Joger 1982). Very similar to *C. poensis*. Synonyms: none. Chromosome number: 2n = 50, FN = 66 (Cameroon; Schlitter *et al.* 1999).

Description Medium-sized shrew. Dorsal pelage brown, paler laterally with fairly abrupt transition to paler ventral pelage; lateral gland silvery-white. Dorsal surface of fore- and hindfeet bicoloured. Tail relatively short (55–65% of HB), dark brown above, paler below; pilosity 85–90%. Skull: second and third unicuspids subequal in size, third upper molar moderately broad. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Montane habitats in Rainforest BZ. Found on Mt Cameroon and the Adamaoua Highlands near Banyo, Cameroon (Heim de Balsac 1957b, Hutterer & Joger 1982)

and in the Gotel Mts, SE Nigeria at 1900 m (Hutterer *et al.* 1992b). Perhaps extends eastwards from Nigeria/Cameroon border to E DR Congo (Hutterer *et al.* 1992b, Wolsan & Hutterer 1998). Eastern part of range needs confirmation.

Habitat Primarily montane forests.

Abundance No information.

Remarks Principal prey probably comprises a range of common invertebrates. Principal predators likely to be owls, reptiles and small carnivores such as mongooses, genets and small cats, which are known to feed on shrews.

Conservation IUCN Category: Least Concern.

Formerly considered as Vulnerable. Major threats are human-induced habitat loss and degradation.

Measurements

Crocidura attila
HB: 80.9 (75–90) mm, n = 8
T: 49 (45–55) mm, n = 8
HF: 13.5 (12–15) mm, n = 8
E: 10 (9–11) mm, n = 7
WT: 5 g
CI: 21.0 (19.5–21.7) mm, n = 8
GWS: 9.0 (8.3–9.5) mm, n = 9
I^1–M^3: 9.0 (8.2–9.5) mm, n = 10
Measurements: Cameroon and DR Congo (BMNH)
Weight: Young ♀, Cameroon (Hutterer *et al.* 1992b)

Crocidura attila

Key References Heim de Balsac & Meester 1977; Hutterer & Joger 1982; Hutterer *et al.* 1992b.

P. D. Jenkins & S. Churchfield

Crocidura baileyi Bailey's Shrew (Simien Shrew)

Fr. Crocidure de Bailey; Ger. Baileys Spitzmaus

Crocidura baileyi Osgood 1936. Field Mus. Nat. Hist., Zool. ser. 20 (21): 225.
Ras Dashan, Simien Mts, Ethiopia. 3400 m (ca. 13° 14' N, 38° 25' E).

Taxonomy Specimens recorded as *C. baileyi* by Osgood (1936) and Yalden *et al.* (1976) are now allocated to *C. lucina* (Dippenaar & Meester 1989). A member of the endemic Ethiopian *C. glassi* complex (*C. glassi*, *C. lucina*, *C. thalia*, *C. macmillani* and *C. baileyi*) (Dippenaar & Meester 1989). Synonyms: none. Chromosome number: not known.

Description Medium-sized *Crocidura* with a distinctly bicoloured pelage and tail. Pelage long, woolly and soft. Dorsal pelage brownish to reddish-brown; hairs grey at base, rufous at tip. Ventral pelage creamy-white, hairs grey at the base, white at tip. Dorsal surface of fore- and hindfeet whitish. Tail of medium relative length (ca. 51% of HB), brown above and whitish below; pilosity 100%. Skull with inflated braincase, as typical for the high altitude Ethiopian *Crocidura*. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Afromontane–Afroalpine BZ. Recorded only in Ethiopia in the highlands west of the Ethiopian Rift Valley (Simien Mts, Amedamit Mts, Enjiabara, Debre Sina and Ankober), 2700–3550 m.

Habitat Humid localities with tall grasses in afroalpine moorland and humid heather forest (Guttinger *et al.* 1998).

Abundance Relatively common in suitable habitats. Comprised 9.8% (17 of 173) of small mammals caught in the Simien Mts (Guttinger *et al.* 1998).

Remarks Woolly fur and relatively short tail might be adaptations to the cold at high altitudes. Presumed to be insectivorous or omnivorous.

Conservation IUCN Category: Endangered.

Crocidura baileyi

Previously considered as Vulnerable. Populations conserved within the Simien Mountains N. P.

Measurements

Crocidura baileyi
HB: 86 (72–93) mm, n = 8
T: 44 (41–46) mm, n = 8
HF: 14.4 (14–16) mm, n = 8
E: n. d.
WT: n. d.
CI: 22.0 (21.6–22.8) mm, n = 5
GWS: 10.2 (10.0–10.4) mm, n = 3
I^1–M^3: 10.1 (9.9–10.2) mm, n = 3
Ethiopia
Body measurements: Osgood 1936
Skull measurements: Dippenaar 1980a, Hutterer 1980

Key References Dippenaar 1980a; Guttinger *et al.* 1998.

Leonid A. Lavrenchenko

Crocidura batesi Bates's Shrew

Fr. Crocidure de Bates; Ger. Bates Spitzmaus

Crocidura batesi Dollman, 1915. Ann. Mag. Nat. Hist., ser. 8, 15: 143. Como River, Gabon.

Taxonomy Often included in *C. poensis* (Hutterer 2005b). Specimens from Cameroon and Gabon recorded as *C. wimmeri* belong to this species. Synonyms: none. Chromosome number: 2n = 50, FN = 76 (Schlitter *et al.* 1999).

Description Small to medium-sized dark chocolate-brown shrew. Dorsal pelage uniform dark chocolate-brown; hairs greyish-brown at base; chocolate-brown at tip. Ventral pelage similar to dorsal pelage or slightly paler. Upper surface of fore- and hindfeet brownish. Tail relatively long (ca. 60–75% of HB), brown above, paler below; pilosity ca. 20–60%. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Rainforest BZ (Gabon subregion). Known only from S Cameroon, Gabon, Equatorial Guinea (Rio Muni) and SW Central African Republic (Hutterer 1993, Ray & Hutterer 1995). Perhaps occurs in N Congo. Distribution limits uncertain.

Habitat Lowland rainforest. Recorded at all three altitudinal zones (110 m, 375 m, 625 m) on Mt Doudou, Gabon; seems to have preference for lower and wetter habitats near river margins (Goodman & Hutterer 2004).

Abundance Uncommon or rare. Represented 1.2% (2 of 160; 11 spp.) of captures in Belinga-Makokou, Gabon (Brosset 1988), 11.2% at Mt Alen, Equatorial Guinea (Lasso *et al.* 1996), 11.1% in

Crocidura batesi

Ngotto Forest, Central African Republic (Barrière & Nicolas 2000) and 9% in SW Gabon (Nicolas *et al.* 2003). On Mt Doudou, Gabon, found at four of nine localities sampled; where found, comprised 6–17% of all shrews (1 of 16, 8 spp.; 1 of 6, 5 spp.; 1 of 11, 6 spp.; 1 of 8; 3 spp.) (Goodman & Hutterer 2004).

Remarks Found in 3.2% of 311 small carnivore scats collected in Dzanga-Sangha, Central African Republic (Ray & Hutterer 1995, Ray 1998). One ♀ caught in Feb contained two small embryos (label, BMNH; Dja R., Cameroon).

Conservation IUCN Category: Least Concern.

Measurements
Crocidura batesi
HB: 78 (72–88) mm, n = 4
T: 57.9 (52–60) mm, n = 4
HF: 14.3 (14–15) mm, n = 4
E: 11.5 (11–12) mm, n = 4
WT: 12.7 (9.1–15.5) g, n = 4
CI: 24.0 (23.1–25.2) mm, n = 3
GWS: 10.0 (9.2–10.9) mm, n = 4
I^1–M^3: 11.6 (10.6–12.2) mm, n = 4
Body measurements and weight: Mt Doudou, Gabon (Goodman & Hutterer 2004)
Skull measurements: Cameroon (BMNH)

Key Reference Goodman & Hutterer 2004.

Justina C. Ray & Rainer Hutterer

Crocidura bottegi Bottego's Shrew

Fr. Crocidure de Bottego; Ger. Bottegos Spitzmaus

Crocidura bottegi Thomas, 1898. Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, 18: 677. 'Between Badditu and Dime', NE L. Turkana, Ethiopia.

Taxonomy West African populations previously allocated to *C. bottegi* (Hutterer & Happold 1983) are now considered to represent *C. obscurior*. Synonyms: none. Chromosome number: not known.

Description Minute shrew. Dorsal pelage rich chocolate-brown with russet tinge. Ventral pelage slightly paler. Ears dark brown. Fore- and hindlimbs with brown hairs; claws short. Tail of medium relative length (ca. 60% of HB); pilosity ca. 80%. Skull with high and rounded braincase, rostrum short, interorbital and maxillary region short but wide. Front dentition weak. Third upper molar rather wide. Nipples: not known.

Geographic Variation None recorded. Populations from Ethiopia should be compared with those from Kenya.

Distribution Endemic to Africa. Afromontane–Afroalpine BZ. Known from three localities in the highlands of Ethiopia (Yalden *et al.* 1976) and from Marsabit, N Kenya (Aggundey & Schlitter 1986).

Habitat No detailed habitat information is available.

Abundance No information.

Remarks Apparently no other information available.

Conservation IUCN Category: Data Deficient.

Measurements
Crocidura bottegi
HB: 46, 51 mm, n = 2
T: 29, 30 mm, n = 2
HF: 9, 9 mm, n = 2

Crocidura bottegi

E: 7 mm, n = 1
WT: 4 g, n = 1
CI: 14.9, 15.2 mm, n = 2
GWS: 6.5, 7.2 mm, n = 2
I^1–M^3: 6.2 (6.1–6.2) mm, n = 3
Ethiopia (Hutterer & Yalden 1990)

Key Reference Hutterer & Yalden 1990.

Rainer Hutterer

Crocidura bottegoides Bale Shrew (Tricoloured Pygmy Shrew)

Fr. Crocidure de Bale; Ger. Bale Spitzmaus (Dreifarbige Zwergspitzmaus)

Crocidura bottegoides Hutterer and Yalden, 1990. *In*: Vertebrates in the Tropics (eds G. Peters & R. Hutterer), Bonn, p. 67. Katcha Camp, Harenna Forest, Bale Mts, Ethiopia. 2400 m.

Taxonomy Synonyms: none. Chromosome number: 2n = 36, FN = 60 (Lavrenchenko *et al.* 1997).

Description Very small shrew with tricoloured pelage. Narrow dark brown band (6–8 mm) runs from top of the head along mid-back towards tail, bordered on each side by a yellowish-brown band of about the same breadth. Ventral pelage, limbs and tail creamy-brown (two specimens) or reddish-brown (one specimen). Claws short. Tail relatively very long (ca. 82% of HB); pilosity 0%. Braincase high and rounded, rostrum short and broad, interorbit and maxillary region short but wide. Dentition gracile, particularly the first upper incisor. Third upper molar medium. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Afromontane–Afroalpine BZ of Ethiopia. Known only from two regions in Ethiopia: Harenna Forest in the Bale Mts, and Mt Albasso, Arussi (Hutterer & Yalden 1990, Yalden & Largen 1992, Lavrenchenko *et al.* 1997). Allopatric to *C. bottegi* (of similar size), which is also an Ethiopian endemic.

Habitat Relict forests. Found in a grassy clearing in *Schefflera/Hagenia* forest at 2400 m, and beneath a log in *Erica arborea* woodland at 3280 m (Hutterer & Yalden 1990). A larger species, *C. harenna* (mean WT: 7.8 g,) also lives in Harenna Forest, but in forested habitats.

Abundance Appears to be uncommon in Harenna Forest (Yalden 1988).

Remarks Apparently no other information available.

Conservation IUCN Category: Endangered.

Measurements

Crocidura bottegoides

HB: 54 (46–57) mm, n = 3

Crocidura bottegoides

T: 44.3 (43–47) mm, n = 3
HF: 10.3 (10–11) mm, n = 3
E: 7 (6–8) mm, n = 3
WT: 3.1 (2.5–3.5) g, n = 3
CI: 14.7 (14.3–15.1) mm, n = 3
GWS: 7.1 (7.1) mm, n = 3
I^1–M^3: 5.9 (5.9–6.0) mm, n = 3
Harenna Forest, Ethiopia (Hutterer & Yalden 1990)

Key Reference Hutterer & Yalden 1990.

Rainer Hutterer

Crocidura buettikoferi Büttikofer's Shrew

Fr. Crocidure de Büttikofer; Ger. Büttikofers Spitzmaus

Crocidura buettikoferi Jentink, 1888. Notes Leyden Mus. 10: 47. Robertsport, Liberia.

Taxonomy This species formerly included *attila*, now regarded as a separate species (Hutterer & Joger 1982). Referred to as *Crocidura occidentalis nigeriae* by Sanderson (1940) and Cozens & Marchant (1952) (see Hutterer & Happold 1983). The specimen ascribed to this species from Oda, Ghana (Heim de Balsac 1958) is, in fact, *C. poensis* (Grubb *et al.* 1998). Synonyms: none. Chromosome number: not known.

Description Medium-sized dark-coloured shrew. Dorsal pelage dark chocolate-brown. Ventral pelage paler, greyish-brown. Limbs dark. Tail relatively long (ca. 70% of HB), dark, very sparsely covered with hairs and bristles; pilosity ca. 50%. Skull with a slightly domed braincase, nearly oval in dorsal view; skull smaller and more slender than in sympatric *C. poensis*. Upper first incisor medium and hooked. First unicuspid larger than second and third.

Third molar large. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Rainforest BZ (Western Region and Western Nigeria sub-region). Recorded from S Guinea, Liberia, Côte d'Ivoire, Ghana and Nigeria. Two specimens from Njala, Sierre Leone, and specimens from Wenchi, Ghana are perhaps this species (Grubb *et al.* 1998). Presence in Guinea-Bissau is uncertain.

Habitat Grassland habitats within the Rainforest BZ (rather than rainforest itself), forest relicts in derived savanna, secondary growth, cocoa planations and cleared land.

Abundance Very varied, according to locality and habitat. In three sacred groves on the Accra plains, Ghana, only one individual was found out of a total of 14 shrews of four species of *Crocidura* (Decher & Bahian 1999). At Umuahia, Nigeria, it was considered to be 'one of the commonest ground-living mammals', and at Owerri, Nigeria, 32 specimens were obtained (Cozens & Marchant 1952). In Taï N.P., Côte d'Ivoire, comprised 13% and was the fourth commonest species of shrew (10 spp.) (Churchfield *et al.* 2004). In another study in Taï N.P., uncommon in forest (7.2% of 390 shrews, 9 spp.) but one of the two most abundant species in cocoa–coffee plantations (29.3% of 140 shrews, 7 spp.) (Barrière *et al.* 1999). In Ziama Biosphere Reserve, Guinea, uncommon in primary forest, secondary forest, fields, fallow land and young forest plantations (4.8%–13.2%), but the commonest species (36.4% of 441 shrews, 9 spp.) in old forest plantations (P. Barrière unpubl.).

Remarks In Taî N. P., Côte d'Ivoire, commonest prey items (% frequency of occurrence) in 28 stomachs were representatives of the following taxa: Araneae (46%), ants (46%), adult Coleoptera (36%), Isoptera (32%), Diplopods (18%), Blattodea (18%), Gryllidae (14%), Diptera larvae (11%) and earthworms (11%). Several other taxa were each represented by frequencies of <10%. Most (82%) of the prey were 15 mm or less in length (Churchfield *et al.* 2004).

Conservation IUCN Category: Near Threatened.

Crocidura buettikoferi

Measurements
Crocidura buettikoferi
HB: 72–100 mm, n = 3
T: 51–62 mm, n = 3
HF: 12–15 mm, n = 3
E: 7–9.5 mm, n = 3
WT: n. d.
CI: 21.4–22.7 mm, n = 3
GWS: 9.2–9.9 mm, n = 3
I^1–M^3: 10.0–10.1 mm, n = 3
♀♀ only; mean values not recorded
Umuahia, Nigeria (Hutterer & Happold 1983)

Key References Happold 1987; Hutterer & Happold 1983.

D. C. D. Happold

Crocidura caliginea African Dusky Shrew (Dusky White-toothed Shrew)

Fr. Crocidure sombre; Ger. Dunkle Weißzahnspitzmaus

Crocidura caliginea Hollister, 1916. Bull. Am. Mus. Nat. Hist. 35: 664. Medje, NE DR Congo.

Taxonomy In skull characters resembles *C. yankariensis* (Hutterer & Jenkins 1983). It also shares unusual characteristics with *Paracrocidura schoutedeni* (Hutterer & Dudu 1990). Synonyms: none. Chromosome number: not known.

Description Small to medium-sized dark-brown shrew. Pelage 3.5 mm (on back). Dorsal pelage dark brown. Ventral pelage dark brown. Snout, ears, fore- and hindfeet covered by very short whitish hairs that contrast sharply with the uniformly dark pelage of the body. Ear small relative to head, pale, covering only half the height of the head. Hindfeet relatively short. Tail relatively long (70% of HB), brown; pilosity 20–30%. Skull strongly built, with heavy maxillary processes. The skull differs from the general *Crocidura* type by its rectangular shape, broad maxillary region and narrow interorbital region and long rostrum. Teeth comparatively large and well developed. First upper incisor long and hooked. Second upper incisor (= first unicuspid) most unusual in being twice as large as the second and third upper unicuspids, and in having (mostly in ♂♂) a secondary cusp. Upper molars large. Molar teeth of mandible very well developed. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Rainforest BZ (East Central Region) of NE DR Congo. Until 1990, recorded from only two localities (Medje [type locality] and Masako Forest [near Kisangani]) (Hollister 1916, Hutterer & Dudu 1990), but has since been found to occur in various forests in the vicinity of Kisangani (Mukinzi *et al.* 2006). The geographic range of the species still appears to be very limited.

Habitat In Masako Forest, most *C. caliginea* have been found in secondary forest (40-year-old regrowth) surrounded by primary forest (mono-dominant *Gilbertiodendron* forest). Some have been found in fallow land and in moist areas along creeks (Hutterer & Dudu 1990, Dudu *et al.* 2005). In recent surveys near Kisangani (Mukinzi *et al.* 2006, and unpubl.), it has been found also in primary forest.

Abundance Considered a rare, endemic species but may be relatively abundant locally. Numerically the commonest species during three years of trapping in Masako Forest where it comprised 47% of shrews in secondary forest (n = 36; 8 spp.) and 33% of shrew captures in all habitats (n = 72, 9 spp.) (Dudu *et al.* 2005).

Adaptations External characters of *C. caliginea* suggest a terrestrial species with some modifications towards a semi-fossorial life. Large, heavy teeth are particularly well adapted for crushing tough, chitinous exoskeletons of arthropods.

Foraging and Food Feeds on a wide range of invertebrates, primarily arthropods. Stomach analyses (n = 20) from rainforest in Masako Forest showed that Formicidae were major prey items (100% by frequency), followed by Isoptera (60%), Araneae (60%), adult Coleoptera (55%) and Diplopoda (45%). Invertebrate prey ranged in body length from 3 mm to 20 mm with 85% being <10 mm (Dudu *et al.* 2005).

Social and Reproductive Behaviour No information. The possession of an additional cusp on the second upper incisor in significantly more ♂♂ than ♀♀ (see above) suggests partial sexual dimorphism, which would be most unusual in the Soricidae.

Reproduction and Population Structure No information.

Predators and Diseases No information but principal predators likely to be owls and small mammalian carnivores such as mongooses, genets and small cats known to feed on shrews (Demeter 1981, Ray & Hutterer 1995).

Crocidura caliginea

Conservation IUCN Category: Least Concern.

Formerly assessed as Critically Endangered. A rare endemic species with a very restricted range. Major threats are human-induced habitat loss and degradation of the rainforests.

Measurements

Crocidura caliginea
HB: 69.6 ± 4.4 mm, n = 14
T: 48.7 ± 3.7 mm, n = 12
HF: 11.7 ± 0.5 mm, n = 14
E: 7.1 ± 0.3 mm, n = 12
WT: 8.3 ± 1.3 g, n = 12
CI: 21.8 ± 0.5 mm, n = 20
GWS: 9.6 ± 0.2 mm, n = 20
I^1–M^3: 10.1 ± 0.3 mm, n = 24
DR Congo
Measurements: Hutterer & Dudu 1990
Weight: Dudu *et al.* 2005
Mean ± 1 S.D.

Key References Hollister 1916; Hutterer & Dudu 1990.

S. Churchfield, R. Hutterer & A. Dudu

Crocidura cinderella Cinderella Shrew

Fr. Crocidure cendrée; Ger. Cinderellas Spitzmaus

Crocidura cinderella Thomas, 1911. Ann. Mag. Nat. Hist., ser. 8, 8: 119. 'Gemenjulla, French Gambia' (= Senegal).

Taxonomy The species may be related to *C. tarfayensis* of Morocco and Mauritania (Hutterer 1987). Synonyms: none. Chromosome number: not known.

Description Very small to small pale-coloured shrew. Pelage short (ca. 2 mm) and dense. Dorsal pelage brownish-grey; hairs dark grey on basal two-thirds, pale cream or pale brown subterminally, with russet-brown to pale brown at tip. Ventral pelage pale grey;

hairs grey at base, white at tip. Colour of ventral pelage delineated from dorsal pelage on lower flanks, especially from shoulder to base of tail. Chin, throat and chest grey. Fore- and hindfeet white; claws transparent, pointed and sharp. Tail relatively long (ca. 70% of HB), bicoloured, pale brown above, white below; pilosity ca. 80%. Skull with flat dorsal roof and flat braincase. Rostrum, interorbital and braincase of medium length, maxillary wide. First incisor long and hooked. Third molar medium. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Sudan Savanna and Sahel Savanna BZs of West Africa. Known from scattered localities in Senegal, Mauritania, Gambia, Mali and Niger (Hutterer 1993).

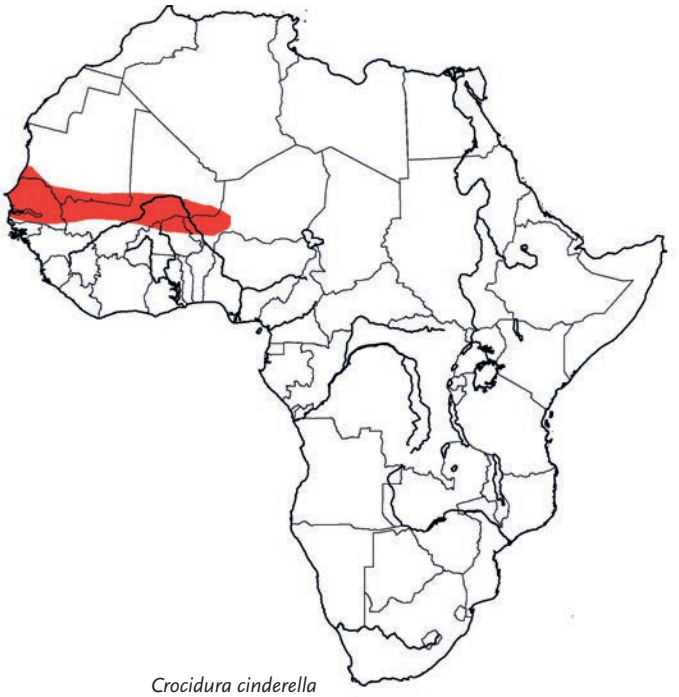
Habitat A specimen from Bandia, Senegal, was collected in dry *Acacia seyal* forest (Böhme & Hutterer 1978); another in a banana plantation at Keur Moussa monastery. *Crocidura cinderella* shares these habitats with *C. fuscomurina*, *C. lamottei*, *C. lusitania* and *C. olivieri* (R. Hutterer unpubl.).

Abundance Appears to be rare. Known from fewer than ten specimens.

Remarks The flat skull and the pale grey pelage perhaps indicates an adaptation to life in rocky fissures in arid habitats.

Conservation IUCN Category: Least Concern.

Measurements
Crocidura cinderella
HB: 67, 50 mm, n = 2
T: 45, 49 mm, n = 2
HF: 11, 12 mm, n = 2



Crocidura cinderella

E: 8.5 mm, n = 1
WT: 5.6 g, n = 1
CI: 18.8 mm, n = 1
GWS: 7.7 mm, n = 1
I^1–M^3: 8.0, 8.3 mm, n = 2
Senegal (ZFMK)

Key Reference Hutterer 1987.

Rainer Hutterer

Crocidura congobelgica Congo Shrew (Congo White-toothed Shrew)

Fr. Crocidure du Congo; Ger. Kongo-Weißzahnspitzmaus

Crocidura congobelgica Hollister, 1916. Bull. Amer. Mus. Nat. Hist. 35: 670. Lubila, near Bafwasende, NE DR Congo.

Taxonomy Probably related to sympatric *C. latona*, which it closely resembles in appearance (Hollister 1916); however, *C. congobelgica* has a larger skull, much wider palate, stronger maxillary processes and larger teeth, but lacks a fovea on the hypoconid of M_3 (present in *C. latona* and *C. caliginea*). Resembles sympatric *C. caliginea* in size and proportions but differs in colour, and is also very similar to *C. buettikoferi*. Synonyms: none. Chromosome number: not known.

Description Small–medium, unicoloured, dark-brown shrew. Dorsal pelage glossy dark-brown, finely streaked with cinnamon-buff. Ventral pelage slightly paler in colour. Fore- and hindfeet thinly clothed in brown hairs. Tail relatively long (ca. 75% of HB), brownish-black, paler underneath at base; nearly naked except for scattered short hairs; pilosity 25%. Skull with large maxillary processes. Unicuspid teeth rounded; first upper unicuspid relatively larger, oval in crown pattern, and with well-developed cingulum. Second and third unicuspids similar to first and approximately equal in size; third unicuspid slightly overlapping the second. Last upper premolar lacks conspicuous posterior emargination, the median space between it and the first molar being very small; length approximately equal to its breadth. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Rainforest BZ (East Central Region). Found only in NE DR Congo and probably endemic to this region. Latterly found in and around Masako Forest Reserve (NE of Kisangani) and in Ituri Forest (NE DR Congo).

Habitat Primary and secondary rainforest. Captured only in fallow land adjacent to rainforest in Masako Forest, DR Congo (Dudu *et al.* 2005).

Abundance Appears to have small, localized populations and is rare in trapped samples. Comprised 14% of shrews (n = 21; 6 spp.) in fallow land, and only 4% of shrews (n = 72; 9 spp.) in all habitats during three years of trapping in Masako Forest, DR Congo (Dudu *et al.* 2005).

Remarks A terrestrial, ground-dwelling species. Feeds on a wide range of invertebrates, primarily arthropods. Stomach analyses (n = 3) contained the following prey: Isoptera, Formicidae, Diptera and Lepidoptera larvae, Heteroptera, Araneae, Chilopoda and Diplopoda. Invertebrate prey ranged in body length from 3 mm to 30 mm but most were <10 mm (Dudu *et al.* 2005).

Conservation IUCN Category: Least Concern.

Species insufficiently known. Probably a species of conservation concern because of its very restricted distribution and small population numbers. At risk from habitat modification and isolation, particularly deforestation.

Measurements

Crocidura congobelgica
HB: 74 mm, n = 1*, 79 mm, n = 2**
T: 59 mm*
HF: 14 mm*
E: n. d.
WT: 17.0 g**
CI: 20.7 mm*
GWS: 9.1 mm*
I^1–M^3: n. d.
DR Congo

Crocidura congobelgica

*Hollister 1916 – holotype
**Dudu *et al.* 2005

Key References Dudu *et al.* 2005; Heim de Balsac 1968b; Hollister 1916.

S. Churchfield, R. Hutterer & A. Dudu

Crocidura crenata Jumping Shrew

Fr. Crocidure sautante; Ger. Springende Weißzahnspitzmaus

Crocidura crenata Brosset, Dubost and Heim de Balsac, 1965. Mammalia 29: 268. Belinga, Gabon.

Taxonomy A comparison of 16s rRNA gene fragments reveals that *C. crenata* is closely related to *C. dolichura* (Quérouil *et al.* 2005). Synonyms: none. Chromosome number 2n = 48 (Primus *et al.* 2006).

Description Small–medium sized, reddish-brown shrew with long hindfoot and long tail. Pelage short (hairs ca. 4 mm) and dense. Dorsal pelage and ventral pelage reddish-brown or russet-brown; hairs grey on basal half, reddish-brown on terminal half. Head similar in colour to dorsal pelage. Long vibrissae. Ears relatively large, darkly pigmented, not concealed by pelage. Fore- and hindfeet flesh-coloured, appear naked but with very short ginger hairs. Tail relatively extremely long (ca. 120% of HB, relatively longer than in most other *Crocidura* of similar size), dark brown, slightly bicoloured; pilosity 0%. Skull long and narrow. Rostrum long, wide and high. Maxillary and braincase narrow, interorbit wide. Braincase highly inflated. Dentition very weak (even compared to *C. dolichura*). First upper incisor short and slightly hooked. Third upper molar medium. Incisor of mandible has two denticles on inner surface. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Rainforest BZ (West Central Region [Eastern Nigeria and Gabon sub-regions]). Recorded from S Cameroon, N Gabon, N Congo and S Central African Republic (Brosset 1988, Hutterer 1993, Hutterer & Schlitter 1996, Ray & Hutterer 1995, Goodman *et al.* 2001, Nicolas *et al.* 2003, Barrière *et al.* 2005). One possible record from Rainforest BZ (East Central Region).

Habitat Rainforest and marshy habitats in rainforest, mostly at lower altitudes; recorded from rainforest in 'montagne' at Belinga, Gabon (Brosset 1988).

Abundance Varies according to habitat and locality. At Mt Doudou, Gabon, found at three altitudes (110 m, 375 m, 625 m), and the second most common species of shrew (17%; 9 spp.) after *Sylvisorex johnstoni* (Goodman & Hutterer 2004). In another study, comprised 9.7% of shrews (14 of 144; 9 spp.) (Nicolas *et al.* 2003). In Minkébé Forest, Gabon, only one specimen was obtained (out of

11) in marshy habitats, and it was not present in drier parts of the forest (Goodman *et al.* 2001). Comprised 1.2% (2 of 160; 11 spp.) in NE Gabon (Brosset 1988).

Remarks Hindfeet extremely long in relation to body size, which may assist in jumping rather than climbing (Brosset 1988). Tail very long; may allow a scansorial life on vines and in dense vegetation; however, not caught in traps placed above ground at Mt Doudou (Goodman & Hutterer 2004).

Conservation IUCN Category: Least Concern.
Status insufficiently known.

Measurements
Crocidura crenata
HB: 72.4 (62–79) mm, n = 7
T: 85.1 (72–91) mm, n = 7
HF: 15.7 (15–16) mm, n = 7
E: 10.1 (7–11) mm, n = 7
WT: 8.4 (7.8–9.1) mm, n = 7
CI: 19 mm, n = 1
GWS: 7.7 mm, n = 1
I^1–M^3: 8.8 mm, n = 1
Body measurements and weight: Gabon (Goodman & Hutterer 2004)
Skull measurements: Gabon (Brosset *et al.* 1965a; holotype)


Crocidura crenata

Key References Brosset 1988; Brosset *et al.* 1965a; Goodman *et al.* 2001.

Rainer Hutterer & Patrick Barrière

Crocidura crossei Crosse's Shrew

Fr. Crocidure de Crosse; Ger. Crosses Moschusspitzmaus

Crocidura crossei Thomas, 1895. Ann. Mag. Nat. Hist., ser. 6, 16: 53. 'Asaba, 150 miles [241 km] up the River Niger', Nigeria.

Taxonomy Resembles *C. gracilipes* in size and colouration. Heim de Balsac & Meester (1977) included *ebriensis*, *ingoldbyi* and *jouvenetae* in *C. crossei*, an arrangement followed by Hutterer (1993). However, Hutterer (2005b) considers the larger *jouvenetae* to represent a separate species (with *ebriensis* as a synonym). Sympatric with *C. jouvenetae* for most of its range. Synonyms: *ingoldbyi*. Subspecies: none. Chromosome number: 2n = 44, FN = 66 (Côte d'Ivoire; Meylan & Vogel 1982; this karyology may be based on specimens of *C. crossei* or *C. jouvenetae*).

Description Small shrew. Dorsal pelage slaty-grey or greyish-brown to chocolate-brown. Ventral pelage greyish and paler. Chin white. Limbs usually dark; fore- and hindfeet brownish-buff. Tail relatively very long (about 84% of HB), quite stout; grey-brown above, paler below; well furnished with small dark hairs and sparsely but evenly distributed with long bristles along most of its length; pilosity ca. 85%. Skull long, with a flat braincase. Dorsal profile of skull angular, sometimes with a marked mid-dorsal break (see also *C. douceti*). Rostrum slender, maxillary region narrow. Anterior upper incisors small and delicate; second and third upper unicuspids approximately equal, their tips about level with the basal cusp of P^4. Nipples: not known.

Geographic Variation Considerable variation in pelage colour from one locality to another, even within the same vegetation zone. Rainforest individuals are generally darker than those in forest–savanna mosaic habitats (Hutterer & Happold 1983).

Distribution Endemic to Africa. Rainforest BZ (Western Region and West Central Region), Northern Rainforest–Savanna Mosaic and Guinea Savanna BZ from Guinea and Sierra Leone to W Cameroon.

Habitat Forest habitats, including lowland rainforest, relic forests in savanna, and tree plantations (Hutterer & Happold 1983, Decher *et al.* 1997). Found at various altitudes, from closed canopy forests along the R. Niger to forests on Mt Cameroon.

Abundance In Gambari Forest, Nigeria, comprised 71% of shrews (2 spp., n = 56) trapped during three years; much more common than the other syntopic species (*C. nigeriae*) (Happold 1977).

Adaptations Primarily terrestrial but also clambers over fallen tree trunks and branches.

Foraging and Food No information, but searches for invertebrate prey in leaf litter, soil crevices and rotting wood.

Social and Reproductive Behaviour Low recapture rates suggest that individuals wander widely and do not remain in the same area for very long. Of 40 marked individuals in rainforest of S Nigeria, only four were captured a second time; of these, three were seen a second time within one month, and the fourth was seen again five months later (Happold 1977, 1987).

Reproduction and Population Structure Pregnant ♀♀ were found in the wet season (Apr, May, Oct and Nov) in S Nigeria (Happold 1977), and in early Dec in Ghana (Decher *et al.* 1997). Litter-size: 2–4 (Nigeria; Happold 1987).

Predators, Parasites and Diseases No information but principal predators likely to be owls, reptiles and small carnivores such as mongooses, genets and small cats known to feed on shrews.

Conservation IUCN Category: Least Concern.

A widespread and relatively common species of no immediate conservation concern.

Measurements

Crocidura crossei

TL (♂♂): 116.6 (114–122) mm, n = 5
TL (♀♀): 117.0 (115–119) mm, n = 4
T (♂♂): 48.0 (45–57) mm, n = 5
T (♀♀): 47.8 (45–50), n = 4
HF (♂♂): 12.2 (11.0–13.0) mm, n = 5
HF (♀♀): 12.3 (12.0–13.0) mm, n = 4
E (♂♂): 9.8 (8.0–11.0) mm, n = 5
E (♀♀): 9.8 (8.0–11.0) mm, n = 4
WT (♂♂): 5.6 (5.0–7.0) g, n = 5
WT (♀♀): 5.1 (4.5–6.0) g, n = 4
CI (♂♂): 18.7 (17.9–19.4) mm, n = 5
CI (♀♀): 18.8 (18.1–19.6) mm, n = 4
GWS (♂♂): 8.0 (7.7–8.2) mm, n = 5
GWS (♀♀): 7.8 (7.5–8.1) mm, n = 4
I^1–M^3 (♂♂): 8.0 (7.7–8.3) mm, n = 5
I^1–M^3 (♀♀): 8.1 (7.9–8.5) mm, n = 4
Ghana (Decher *et al.* 1997)

Crocidura crossei

HB (both sexes): 54–80 mm, n = 10
T (both sexes): 48–57 mm, n = 10
HF (both sexes): 10–12 mm, n = 10
E (both sexes): 6–8 mm, n = 10
WT (both sexes): 6.3–8.0 g, n = 10
CI (both sexes): 18.5–19.9 mm, n = 10
GWS (both sexes): 7.8–8.5 mm, n = 10
I^1–M^3 (both sexes): 7.7–8.6 mm, n = 10
Nigeria (Hutterer & Happold 1983; mean values not recorded)

Key References Decher *et al.* 1997; Happold 1977, 1987; Heim de Balsac & Meester 1977.

S. Churchfield & P. D. Jenkins

Crocidura cyanea Reddish-grey Shrew

Fr. Crocidure de Cyané; Ger. Rotgraue Moschusspitzmaus

Crocidura cyanea (Duvernoy, 1838). Mem. Soc. Hist. Nat. Strasbourg. 'La rivière des Elephants, au sud de l'Afrique' (= Citrusdal, South Africa).

Taxonomy Originally described in the genus *Sorex*. Polytypic. The taxonomic limits of the species are uncertain; and many of the subspecies listed by Heim de Balsac & Meester (1977) are now considered as valid species, or as synonyms of other species. Some names, e.g. *infumata* and *cyanea*, are considered as subspecies by Meester *et al.* (1985), but as synonyms here. Synonyms: *argentatus*, *capensis*, *?capensoides*, *?concolor*, *electa*, *infumata*, *martensii*, *pondoensis*, *vryburgensis* (see Hutterer 2005b for details). Subspecies: none. Chromosome number: not known.

Description Small–medium (♀♀) to medium-sized (♂♂) shrew. Dorsal pelage brownish-grey, grizzled with pale yellow; hairs slaty-grey at base, with pale-grey or yellowish subterminal bands and brown tip. Ventral pelage paler grey with a yellow or brown tinge in older specimens; hairs slaty-grey at base with silvery-grey tip. Head slender with long, narrow pointed muzzle, small eyes and rounded ears. Fore- and hindfeet yellow to pale brown; each with five digits. Tail relatively long (ca. 69% of HB), pale to dark brown above; paler below; pilosity ca. 50%. Males on average larger than ♀♀. Nipples: 0 + 3 = 6.

Geographic Variation Western forms are generally paler than the eastern ones. There is also variation in size in different parts of the range.

Distribution Endemic to Africa. Widespread in Zambezian Woodland BZ and South-West Arid BZ (but excluding much of the Kalahari Desert). Recorded from N Zambia and N Mozambique southwards to southern Africa, and then northwards through C Namibia. Conspicuously absent from E Namibia, N Botswana, N–C Karoo and C Mozambique.

Habitat Montane forest and grassland, vleis, dense shrubs, savanna, grasslands and rocky outcrops. Has a remarkably wide habitat tolerance.

Abundance Widespread and comparatively common in some areas.

Adaptations Predominantly nocturnal and terrestrial. In C Namibia, there is a cave-dwelling population where individuals penetrate 150 m into the cave, apparently thriving on the numerous invertebrates, such as ptinid beetles, apterous crickets and pseudoscorpions that are found there (Marais & Irish 1990). Shrews were collected from areas in the cave where large numbers of bats roost, and may well feed on carcasses that are fairly common at those sites.

Foraging and Food Insectivorous (Monadjem 1997).

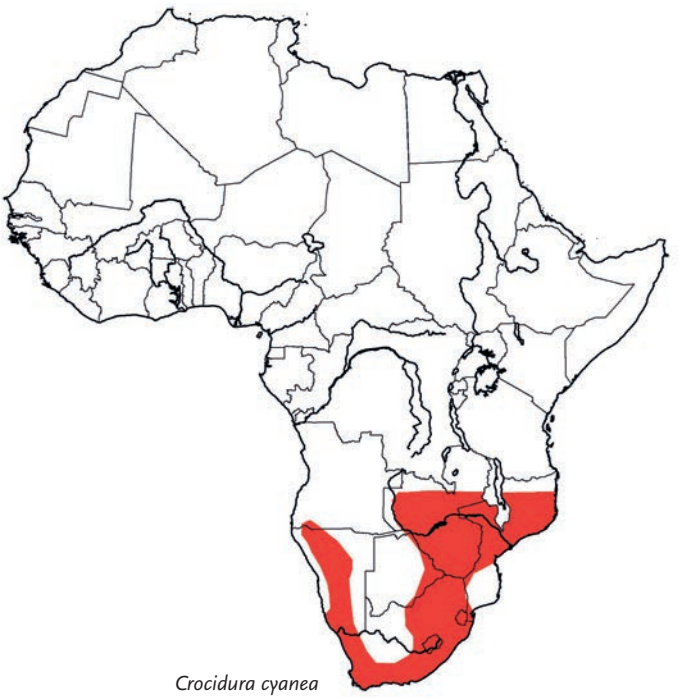
Social and Reproductive Behaviour Solitary.

Reproduction and Population Structure In South Africa, reproductive activity occurs during the wet season (Sep–Apr) (Rautenbach 1982, Lynch 1983, Skinner & Smithers 1990). In KwaZulu–Natal Province, South Africa, a pregnant specimen was collected during the dry season (Jul) (Taylor, P. 1998). Probably breeds opportunistically. Mean litter-size: 3.3 (range 2–6; mode 4; n = 12) (Rautenbach 1982, Lynch 1983, Taylor, P. 1998).

Predators, Parasites and Diseases Remains of this species have been recovered from the pellets of Barn Owls *Tyto alba*.

Conservation IUCN Category: Least Concern.
A relatively common shrew.

Measurements
Crocidura cyanea
HB (♂♂): 89 (67–93) mm, n = 23
HB (♀♀): 74.7 (68–89) mm, n = 19



Crocidura cyanea

T (♂♂): 52.8 (42–69) mm, n = 23
T (♀♀): 48.0 (33–55) mm, n = 19
HF (♂♂): 13.0 (11–14.5) mm, n = 21
HF (♀♀): 12.5 (12–14) mm, n = 19
E (♂♂): 9.3 (8–11) mm, n = 22
E (♀♀): 8.6 (7.5–11) mm, n = 17
WT: n. d.
CI (♂♂): 21.1 (19.6–22.0) mm, n = 19
CI (♀♀): 20.5 (19.6–21.4) mm, n = 11
GWS (♂♂): 9.3 (8.4–9.8) mm, n = 18
GWS (♀♀): 9.1 (8.8–9.4) mm, n = 12
I^1–M^3 (♂♂): 9.0 (7.9–9.5) mm, n = 24
I^1–M^3 (♀♀): 8.8 (8.3–9.6) mm, n = 16
Citrusdal, South Africa (Meester 1963, as *C. c. cyanea*)

Key References Lynch 1983; Meester 1963; Skinner & Smithers 1990.

R. M. Baxter & N. J. Dippenaar

Crocidura denti Dent's Shrew (Dent's White-toothed Shrew)

Fr. Crocidure de Dent (Crocidure d'Ituri); Ger. Dents Spitzmaus

Crocidura denti Dollman, 1915. Ann. Mag. Nat. Hist., ser. 8, 16: 377. Between Mawambi and Avakubi, Ituri Forest, DR Congo.

Taxonomy Originally described as a subspecies of *C. jacksoni*. West African records for this species (Ziegler *et al.* 2002) need confirmation. Preliminary genetic data suggest that the species is composite and perhaps includes more than one species (Quérouil *et al.* 2005). No synonyms. Chromosome number: not known.

Description Small dark brown shrew with hairy tail. Dorsal pelage dark brown. Ventral pelage slate-grey. Tail relatively long (ca. 65–70% of HB), brown above, paler below; pilosity 66–75%. Skull stout with short and broad snout. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Rainforest BZ; widespread but disjunct. Recorded from Cameroon, Gabon and NE DR Congo; may occur in N Congo. Records from Guinea and Sierra Leone need confirmation (see above).

Habitat Swamp forest in Guinea (Ziegler *et al.* 2002), gallery forest in montane savanna in Adamoua Highlands, Cameroon (Hutterer & Joger 1982), secondary forest in Masako Forest Reserve (Dudu *et al.* 2005).

Abundance The most common shrew captured by owls (25% of 64) in the Adamaoua Highlands, Cameroon (Hutterer & Joger 1982). Formed 19.4% of shrew captures (n = 72) in Masako Forest, DR Congo (Dudu *et al.* 2005). Elsewhere, rarely captured.

Remarks Stomach analyses from rainforest in Masako Forest showed that Isoptera were major prey items (30% by composition), followed by Diplopoda (13.6%), Formicidae (11.4%), Coleoptera (9.6%), Araneae (8.5%), Blattoidea (6.0%), Heteroptera (5.5%), Lepidoptera (5.5%), Diptera larvae (4.3%) and Acrididae (<1%) (Dudu *et al.* 2005). Remains of this species were found in 2.9% of 311 small carnivore scats collected in Dzanga-Sangha, Central African Republic (Ray & Hutterer 1995; Ray 1998).

Conservation IUCN Category: Least Concern.

Measurements
Crocidura denti
HB: 63 mm, n = 1
T: 46 mm, n = 1
HF: 13 mm, n = 1
E: 8 mm, n = 1
WT: 10.5 (8–12) g, n = 8

Crocidura denti

CI: 20.6 mm, n = 1
GWS: 9.3 mm, n = 1
I^1–M^3: 9 mm, n = 1
Measurements: Ituri Forest, DR Congo (Dollman 1915e; holotype)
Weight: Central Afrcan Republic (Ray & Hutterer 1995)

Key References Dudu *et al.* 2005; Hutterer & Joger 1982.

Justina C. Ray & Rainer Hutterer

Crocidura desperata Desperate Shrew

Fr. Crocidure triste; Ger. Rasende Spitzmaus

Crocidura desperata Hutterer, Jenkins and Verheyen, 1991. Oryx 25: 165. Rungwe Mts, S Tanzania. Above 2000 m.

Taxonomy Relationships of this shrew are still unresolved (Hutterer 2005b). Synonyms: none. Chromosome number: not known.

Description Medium-sized greyish-brown shrew. Pelage long, dense and woolly; dorsal hairs 10 mm. Dorsal pelage deep greyish-brown, slightly speckled. Ventral pelage pale grey. Colour of dorsal and ventral pelages merge. Fore- and hindfeet pale grey (as ventral pelage). Claws well developed: claws on forefeet 2.5–2.6 mm, claws on hindfeet 2.6–2.9 mm. Tail relatively long (ca. 75% of HB), thick at base, bicoloured, brown above, grey below; pilosity 70–76%. Skull large, rather flat. First incisor long and hooked. Skull large, rostrum elongated, interorbital region narrow. Upper incisor long and gracile. First unicuspid larger, second and third unicuspids smaller and equal. Upper last molar small. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Known only from the Rungwe and Udzungwa (Uzungwa) Mts, S Tanzania. Not known from any of the other Eastern Arc Mts in Tanzania.

Habitat Bamboo zone and relict montane forests above 2000 m (Hutterer *et al.* 1991).

Abundance Extremely localized.

Remarks Some of the characteristics of the body, e.g. long claws on hindfeet (similar to those of *Myosorex* spp.), comparatively small ears and dorsal surface of hindfoot with small scales and relatively few hairs suggest that these shrews may be partly fossorial. Elongated incisors suggest that earthworms may form part of the diet (Hutterer *et al.* 1991).

Conservation IUCN Category: Endangered.

Measurements
Crocidura desperata
HB: 89.0 (80–101) mm, n = 4
T: 67 mm, n = 4
HF: 18.7 (18.5–19) mm, n = 4
E: 8.1 (7.1–8.5) mm, n = 4
WT: 23.3 (16–27) mm, n = 4
CI: 25.9 (25.0–27.0) mm, n = 4
GWS: 10.9 (10.6–11.0) mm, n = 4
I^1–M^3: 11.2 (10.6–11.8) mm, n = 4
Tanzania (ZFMK)

Key Reference Hutterer *et al.* 1991.

Rainer Hutterer

Crocidura desperata

Crocidura dolichura Long-tailed Shrew (Long-tailed Musk Shrew)

Fr. Crocidure à queue longue; Ger. Langschwanz Spitzmaus

Crocidura dolichura Peters, 1876. Monatsb. K. Preuss. Akad. Wiss. Berlin 1876: 475. Bonjongo, Cameroon.

Taxonomy The taxa *latona*, *ludia*, *muricauda* and *polia* were included in *C. dolichura* by Heim de Balsac & Meester (1977) but are regarded as valid species by Hutterer & Dippenaar (1987a) and Hutterer (1993, 2005b). Sister taxon of *C. crenata* (Quérouil *et al.* 2005). Synonyms: none. Chromosome number: not known.

Description Small grey-brown shrew. Dorsal pelage uniform deep greyish-brown. Ventral pelage slightly paler grey. Hindfeet relatively short. Hind- and forefeet with scattered white hairs. Tail relatively extremely long (125–150% of HB); pilosity 0%. Skull laterally depressed and rounded, braincase oval. Dorsal profile with straight rostrum and inflated braincase. Dentition weak, I^1 and subsequent unicuspids very small; M^3 large. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Rainforest BZ (West Central and East Central Regions). Recorded from S Nigeria, S Cameroon, N Gabon, S Central African Republic, DR Congo (N of Congo R.), Uganda and Burundi. Also Bioko I.

Habitat Primary and secondary rainforests over a wide range of altitudes. In E DR Congo, found in primary rainforests, secondary rainforests and montane forests (e.g. *Neoboutonia* and mixed forests), but not found in swamps or in cultivations (Dieterlen & Heim de Balsac 1979).

Abundance Uncommon. Proportional abundance varies from 4% to 9% depending on the shrew community and location. Comprised 4% of captured shrews at Mt Alen, Equatorial Guinea (n = 26; 8 spp.; Lasso *et al.* 1996), 4% at Mt Doudou, SE Gabon (n = 503; 9 spp.; Nicolas *et al.* 2004), 4.5% in SW Gabon at 110 m (n = 44; 9

Crocidura dolichura

spp.; Goodman & Hutterer 2004), 7.5% at Belinga-Makokou, Gabon (n = 160; 11 spp.; Brosset 1988), 8% in Korup National Park, S Cameroon (n = 24; 9 spp.; Hutterer & Schlitter 1996) and 9% in marshland at Minkébé Reserve, Gabon (n = 11, 7 spp.; Goodman *et al.* 2001).

Remarks The long tail may be used for balance (Hutterer & Happold 1983). Embryo number: 2.5 (2–3, n = 2; Belinga-Makokou, Gabon; Brosset 1988). Stomach contents (n = 1) includes representatives of the following: Formicidae, adult Diptera, Lepidoptera larvae, Diplopoda and Araneae (Dudu *et al.* 2005). Found in 3.9% of 311 small carnivore scats collected in Dzanga-Sangha, Central African Republic (Ray & Hutterer 1995; Ray 1998).

Conservation IUCN Category: Least Concern.

Measurements
Crocidura dolichura
HB: 60, 70 mm, n = 2
T: 73, 75 mm, n = 2
HF: 12, 13 mm, n = 2
E: 9, 10 mm, n = 2
WT: 5.6 (4–7) g, n = 11
CI: 18.8, 19.5 mm, n = 2
GWS: 8.1, 8.4 mm, n = 2
I^1–M^3: 7.9, 8.3 mm, n = 2
Measurements: Nigeria (Hutterer & Happold 1983)
Weight: Central African Republic (Ray & Hutterer 1995)

Key References Dieterlen & Heim de Balsac 1979; Hutterer & Happold 1983.

Justina C. Ray & Rainer Hutterer

Crocidura douceti Doucet's Shrew (Doucet's Musk Shrew)

Fr. Crocidure de Doucet; Ger. Doucets Moschusspitzmaus

Crocidura douceti Heim de Balsac, 1958. Mem. Inst. Fr. Afr. Noire 53: 329. Adiopodoume, Côte d'Ivoire.

Taxonomy Very similar to *C. muricauda* but apparently not closely related; exact genetic relations unknown (Quérouil *et al.* 2005). Synonyms: none. Chromosome number: not known.

Description Very small shrew. Dorsal pelage greyish-brown to chocolate-brown; hairs uniformly coloured. Ventral pelage grey to off-white. Fore- and hindlimbs with pale hairs. Tail relatively long (ca. 80% of HB), dark and thin, with small hairs and dark bristles; pilosity 20%. Skull similar to *C. crossei* (dorsal profile flatter) and *C. muricauda* (skull larger); rostrum short. Upper and lower dentition weak, particularly the first incisor and unicuspids. M^3 large. Nipples: not known.

Geographic Variation Dorsal pelage darker in northern populations. Heim de Balsac & Aellen (1958) remarked that specimens from Serédou, Guinea, had longer tails and differed in colouration from the typical form and could represent a 'slightly different race'. The phylogenetic relations between the populations from Guinea to Nigeria are unresolved.

Distribution Endemic to Africa. Primarily Guinea Savanna BZ and margins of Rainforest BZ (Western Region, Guinea); also coastal forest relicts (Côte d'Ivoire). Recorded from Guinea and Côte d'Ivoire (Hutterer 2005b). Records from Nigeria (Hutterer & Happold 1983) are questionable (and not mapped). Distribution limits uncertain.

Habitat Relict and riverine forests in savannas. Also found in mixed secondary forest and swampy areas in the Taï Forest (Churchfield *et al.* 2004), and in moist tall grass-forest habitats near Adiopodoumé, Côte d'Ivoire (Heim de Balsac & Aellen 1958). Also found in a relict forest at base of inselberg (Abuja, Nigeria) (D. C. D. Happold unpubl.).

Abundance Rarely collected and abundance usually low: comprised 7% of shrews (n = 194) caught in secondary forest of Taï N. P., Côte d'Ivoire (Churchfield *et al.* 2004); 3.2% of shrews (n = 390; 9 spp.) in forest and 1.4% of shrews (n = 140; 7 spp.) in cocoa–coffee plantations in Taï N. P. (Barrière *et al.* 1999); 1% of shrews (n = 96) in the Mt Nimba area (Heim de Balsac 1958); 1.3% of shrews (n = 79) in lower Côte d'Ivoire (Heim de Balsac & Aellen 1958); and 3.6% (n = 303; 10 spp.) in forest plantations, 5.6% (n = 500; 11 spp.) in primary forest and up to 8.8% (n = 272, 9 spp.) in fields in Ziama Biosphere Reserve, Guinea (P. Barrière unpubl.).

Crocidura douceti

Adaptations The long tail may be a modification towards a scansorial life. A nest containing two juveniles was found some 10 m above ground in a cavity of a palm tree (Heim de Balsac & Vuattoux 1969), and another specimen was found in a glue trap in the canopy of Taï Forest (Churchfield *et al.* 2004).

Foraging and Food Feeds on a wide range of invertebrates, primarily arthropods. Stomach analyses (n = 14) from Taï N. P. showed that Formicidae were major prey items (50% by frequency of occurrence), followed by Coleoptera (29%), Araneae (29%), Isoptera (29%) and some other groups of minor importance. Invertebrate prey ranged in body length from 3–20 mm with ca. 80% being <10 mm (Churchfield *et al.* 2004).

Reproduction and Population Structure Embryo number: 2 (n = 1; Côte d'Ivoire; Heim de Balsac 1958).

Conservation IUCN Category: Data Deficient.

Measurements
Crocidura douceti
HB: 50–55 mm, n = 5
T: 40–45 mm, n = 5
HF: 10 mm, n = 5
E: 8 mm, n = 5
WT: 4–5 g, n = 5
CI: 16.4–17.3 mm, n = 5
GWS: 7.0–7.5 mm, n = 5
I^1–M^3: 6.8–7.5 mm, n = 5
Nigeria (Hutterer & Happold 1983; mean values not recorded)

Key References Churchfield *et al.* 2004; Happold 1987; Hutterer & Happold 1983.

Rainer Hutterer & D. C. D. Happold

Crocidura eisentrauti Eisentraut's Shrew

Fr. Crocidure d'Eisentraut; Ger. Eisentrauts Spitzmaus

Crocidura eisentrauti Heim de Balsac, 1957. Zool. Jahrb. Abt. Syst. Oekol. Geogr. Tiere 85: 616.
Johann-Albrecht-Hütte, 2900 m, Mt Cameroun, Cameroon.

Taxonomy This species is not conspecific with *C. vulcani* (*contra* Heim de Balsac 1957b; see Hutterer 2005b). Synonyms: none. Chromosome number: not known.

Description Small–medium brown shrew. Pelage soft and dense; hairs 4–5 mm on mid-dorsal line. Dorsal pelage brown to soft reddish-brown; hairs grey on basal half, brown on terminal half. Ventral pelage greyish-brown; hairs grey at base, pale brown to greyish-brown or white at tip. Ears dark, anterior part partly concealed by hairs. Fore- and hindfeet brown or greyish-brown. Tail relatively long (ca. 79% of HB), bicoloured, brown above, pale or whitish below; pilosity 33–50%. Skull flattish rising slightly at posterior end. Upper incisor small and hooked. First unicuspid large and slightly pointed; second and third unicuspids subequal in size; all three with weakly developed cingulum. Third upper molar medium-sized. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Afromontane–Afroalpine BZ. Recorded only on Mt Cameroon, Cameroon (1850–3000 m).

Habitat At higher altitudes (Pic Isabel, ca. 3000 m), lives in alpine grasslands. Habitat at lower altitudes (e.g. Refugium, 2000 m) is '*Schefflera* montane forest' (1400–2600 m).

Abundance Uncertain; at 3000 m, Heim de Balsac (1959a) found six specimens of this species, and one specimen of *Sylvisorex morio*.

Remarks Two pregnant ♀♀ at 3000 m in Apr; one contained two embryos (Heim de Balsac 1959a) and the other contained three embryos (labels ZFMK).

Conservation IUCN Category: Vulnerable.

Measurements
Crocidura eisentrauti
HB: 72.3 (68–78) mm, n = 9
T: 57.2 (53–62) mm, n = 9
HF: 12.7 (11–14) mm, n = 9
E: 8.7 (6–10) mm, n = 9

Crocidura eisentrauti

WT: 9.1 (8–11) g, n = 8
CI: 19.7 (19.5–20.4) mm, n = 6
GWS: 8.6 (8.4–9.0) mm, n = 6
I^1–M^3: 8.3 (7.9–8.8) mm, n = 6
Mt Cameroon, Cameroon (ZFMK)

Key Reference Eisentraut 1963.

Rainer Hutterer

Crocidura elgonius Elgon Shrew

Fr. Crocidure du Mont Elgon; Ger. Elgon-Spitzmaus

Crocidura elgonius Osgood, 1910. Ann. Mag. Nat. Hist., ser. 8, 5: 369. Kirui, Mt Elgon, Kenya.

Taxonomy Originally described as a subspecies of *C. bicolor* (now *C. fuscomurina*) but regarded as a separate species by Heim de Balsac & Meester (1977) and Hutterer (1983b, 1993). Synonyms: none. Chromosome number: not known.

Description Small brown shrew with short hairs. Dorsal hairs ca. 2 mm; ventral hairs ca. 1.5 mm. Dorsal pelage brown; hairs brown along entire length. Ventral pelage dirty white speckled with grey; hairs dirty white, grey at base. Colour of dorsal pelage clearly delineated from ventral pelage. Ears prominent and devoid of long hairs. Forefeet pale relative to dorsal pelage. Hindfeet dark brown on the distal two toes and edge of foot; yellowish on the inside. Tail of medium relative length (ca. 55% of HB), bicoloured, dark above, pale below; pilosity ca. 66%. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Afromontane–Afroalpine BZ of eastern Africa. Recorded from Kenya (Cherangani Hills, Eldoret, Kisumu, L. Nakuru, Mt Elgon [holotype], Muguga, Nairobi) and Tanzania (East and West Usambara, Uluguru and Udzungwa Mountains) (Aggundey & Schlitter 1986 [and references therein], Stanley *et al.* 1998, Swynnerton & Hayman 1951).

Crocidura elgonius

Habitat Disturbed habitats near montane forest and in other habitats in highlands. In the Udzungwa Mts, common in dry forests at 600 m and absent in wetter forests above 1000 m. Recorded in rotting vegetation at the edge of a swamp (Allen & Loveridge 1942).

Abundance The most numerous shrew in drier forests of the Udzungwa Mts (70% of the shrews observed; n = 23). In the East Usambara Mts, the most common shrew in tea plantations, but absent from samples taken in nearby fragments of montane forests (W. T. Stanley unpubl.).

Remarks Terrestrial and nocturnal. In a sample from forests of the Udzungwa Mts in Aug (1995), ♂ : ♀ ratio was 11 : 5, and age ratio was 1 juvenile : 4 adults (n = 10). Similar ratios were found in samples from the East and West Usambara Mts collected between Jul and Sep (between 1991 and 1993): ♂ : ♀ ratio was 3 : 1 (n = 20), and age ratio was 1 juvenile : 3 adults (n = 16) (W. T. Stanley unpubl.). Remains found in owl pellets collected at Nairobi and L. Nakuru, Kenya (Hutterer 1983b).

Conservation IUCN Category: Least Concern.

May be 'Vulnerable' because of fragmented distribution and decline in suitable habitat.

Measurements

Crocidura elgonius
HB: 62 (55–68) mm, n = 16
T: 36 (33–40) mm, n = 16
HF: 10 (9–11) mm, n = 16
E: 7 (7–8) mm, n = 16
WT: 3.4 (2–4.6) g, n = 16
CI: 16.5 (15.5–17.1) mm, n = 10
GWS: 7.2 (6.1–7.6) mm, n = 10
I^1–M^3: 7.0 (6.6–7.3) mm, n = 10
Udzungwa Mts, Tanzania (W. T. Stanley unpubl.)

Key Reference Hutterer 1983b.

William T. Stanley

Crocidura erica Heather Shrew (Angolan White-toothed Shrew)

Fr. Crocidure d'Angola occidental; Ger. Angola-Spitzmaus

Crocidura erica Dollman, 1915. Ann. Mag. Nat. Hist. ser. 8, 15: 514; ser. 8, 16: 145. Pungo Andongo, Angola.

Taxonomy Relationship to *C. nigricans* uncertain (Crawford-Cabral 1987) but listed as a distinct species (Hutterer 1993, 2005b). Resembles *C. hirta* in cranial dimensions. Synonyms: none. Chromosome number: not known.

Description Large pale-coloured shrew. Dorsal pelage pale grey faintly washed with brown. Flanks greyer, gradually merging with dull grey ventral pelage. Dorsal surface of feet greyish-white. Tail of medium relative length (56% of HB), finely haired, brown above, greyish-white below; pilosity 45%. Skull: second unicuspid larger than third; third upper molar medium in size; talonid of third lower molar reduced to a single cusp. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Zambezian Woodland BZ. Recorded only from W Angola (Heim de Balsac & Meester 1971, Hutterer 1993, 2005b).

Habitat No information. The holotype was found at 1098 m.

Abundance No information.

Remarks Apparently no other information available.

Conservation IUCN Category: Data Deficient.

Major threats are human-induced habitat loss and degradation, and restricted distribution.

Crocidura erica

Measurements

Crocidura erica
HB: 96 mm, n = 1
T: 54 mm, n = 1
HF: 15 mm, n = 1
E: 8 mm, n = 1
WT: n. d.
CI: 22.4, 23.3 mm, n = 2
GWS: 9.7, 10.2 mm, n = 2
I^1–M^3: 10.2, 10.3 mm, n = 2
Pungo Andongo, Angola (Dollman 1915d)

Key References Crawford-Cabral 1987; Wolsan & Hutterer 1998.

P. D. Jenkins & S. Churchfield

Crocidura fischeri Fischer's Shrew

Fr. Crocidure de Fischer; Ger. Fischers Spitzmaus

Crocidura fischeri Pagenstecher, 1885. Jahrb. Wiss. Anst., Hamburg 2: 34, pl. 1, f. 1–3. Nguruman, Kenya.

Taxonomy Most of the records for this species listed by Heim de Balsac & Meester (1977) are not this species (Hutterer 1986a). Synonyms: none. Chromosome number: not known.

Description Medium-sized shrew. Dorsal pelage bluish-grey with brownish tinge. Ventral pelage white; hairs grey on basal half, white on terminal half. Upper lips, throat, and behind ears white; fore- and hindfeet white; all hairs grey on basal half, white on terminal half. Tail of medium relative length (ca. 59% of HB in ♀♀; 53% of HB in ♂♂), pale pink (skin) thick at base, tapering towards tip, pilosity 100%. Skull: upper first incisor long and hooked. First upper unicuspid very large, double the size of second and third unicuspids. Third upper molar small. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Somalia–Masai Bushland BZ. Only known from Nguruman in S Kenya (north of L. Natron) and Himo, N Tanzania.

Crocidura fischeri

Habitat Grasslands of *Acacia* savanna woodland where widely scattered *Acacia tortilis* are the dominant species of tree, and *Themeda*, *Hyparrhenia* and *Cenchrus* are the common grasses. Due to heavy grazing by livestock, the area becomes denuded during the dry season and when daytime temperatures may reach 40 °C.

Abundance Locally abundant forming 78% of shrew captures at Nguruman.

Remarks Terrestrial and nocturnal. In Jun (1998), seven individuals were captured; of the four ♀♀, three had a perforate vagina suggesting they were in reproductive condition. The three ♂♂ were not in reproductive condition.

Conservation IUCN Category: Data Deficient.

More information is required before a valid assessment can be given.

Measurements

Crocidura fischeri
HB (♂♂): 89 (82–97) mm, n = 3
HB (♀♀): 82 (65–92) mm, n = 4
T (♂♂): 47 (41–57) mm, n = 3
T (♀♀): 49 (42–57) mm, n = 4
HF (♂♂): 13.3 (13.2–13.5) mm, n = 3
HF (♀♀): 12.7 (12–13) mm, n = 4
E (♂♂): 9 (7.5–10.5) mm, n = 3
E (♀♀): 10.3 (9.4–11.7) mm, n = 4
WT (♂♂): 14.8 (14.5–15) g, n = 3
WT (♀♀): 13.1 (11–15) g, n = 4
CI: 26.0*, 27.4** mm n = 2
GWS: 11.5 mm, n = 1**
I^1–M^3: 11.4 mm, n = 1**
Body measurements and weight: Nguruman, SE Kenya (N. O. Oguge unpubl.)
*Holotype – Nguruman, SE Kenya (see Hutterer 1986a)
**Tanzania (Hutterer 1986a)

Key Reference Hutterer 1986a.

N. Oguge

Crocidura flavescens Greater Red Shrew (Greater Red Musk Shrew)

Fr. Crocidure grande; Ger. Afrikanische Riesenspitzmaus

Crocidura flavescens (I. Geoffroy, 1827). Dict. Class. Hist. Nat. 11: 324; Mem. Mus. Hist. Nat. Paris 15: 126.
'La Cafrèrie et le pays de Hottentots' (= King William's Town, South Africa).

Taxonomy Originally described in the genus *Sorex*. The name *flavescens* previously used for forms now considered as species or synonyms of other species, especially *C. olivieri*, e.g. *atlantis*, *bueae*, *darfurea*, *hedenborgiana*, *hera*, *manni*, *martiensseni*, *occidentalis*, *spurelli*, *sururae*, *zuleika*. The name *flavescens* is now restricted to giant shrews from southern Africa. Synonyms: *capensis*, *cinnamomeus*, *knysnae*, *rutilus*. Subspecies: none. Chromosome number: 2n = 50 (South Africa; Maddalena *et al.* 1987).

Description Very large brown shrew. Dorsal pelage fawn to cinnamon-brown; hairs slaty-grey at base, pale subterminal band and brown tip. Ventral pelage pale grey or yellowish-grey; hairs dark grey at base, off-white to pale yellow at tip; ventral colour merges fairly abruptly with dorsal colour on flanks. Head slender with long, narrow pointed muzzle, small eyes and rounded ears. Fore- and hindfeet fawn with five digits. Tail of medium relative length (ca. 49% of HB), brown above, pale grey below; covered with sparse long hairs; pilosity ca. 65–80%. Nipples: 0 + 3 = 6.

Geographic Variation None recorded.

Distribution Endemic to Africa. Occurs in several biotic zones close to the coast of South Africa, and parts of the Highveld BZ. In South Africa, recorded along the escarpment of E Mpumalanga Province, the coastal regions of Western Cape and Eastern Cape Provinces, and throughout most of KwaZulu–Natal. Also recorded in E Lesotho, Swaziland and the Inhambane district of S Mozambique (Meester 1963, Meester *et al.* 1986, Monadjem 1998a, c, Taylor, P. 1998).

Habitat Usually occurs close to water where there is adequate ground cover. Trapped in a variety of vegetation types including fynbos, grasslands (montane, temperate and sub-tropical), coastal forest, woodlands, savanna and disturbed habitats in higher rainfall regions of South Africa. Commensal with humans and enters dwellings. Wide habitat tolerance.

Crocidura flavescens

Abundance Relatively common especially in sub-tropical habitats of its range. Very abundant in gardens in Pietermaritzburg, South Africa.

Adaptations Predominantly nocturnal with greatest peak of activity at dawn and a secondary peak at dusk (Baxter *et al.* 1979). Enters spontaneous torpor (Baxter 1996) during adverse environmental conditions, but exhibits no other special physiological adaptations (Brown *et al.* 1997). Very high levels of aggression (Baxter & Irwin 1995) assist it in killing vertebrate prey larger than itself.

Foraging and Food Feeds opportunistically on invertebrates and vertebrates; cannibalistic and also a scavenger. Diet includes insects, snails, earthworms, reptiles and rodents (Baxter 1977).

Social and Reproductive Behaviour Aggressive and territorial with probable overlap of male and female territories (Baxter & Irwin 1995). Territories are probably demarcated through scent-marking using lateral, chin and ano-genital glands and strongly scented faecal piles (Baxter & Meester 1982).

Vocalization includes (a) a loud, strident squeak when alarmed, (b) squeaks interspersed with 'chirrs' or chittering sounds during aggressive encounters, (c) chittering in female–young interactions and (d) soft, repetitive squeaks when foraging (Baxter & Meester 1982). Although vocalization has ultrasonic properties (up to 50 kHz), it is not used for echolocation (Irwin & Baxter 1980). Grooming behaviour includes scratching with the hindfeet, face-washing and occasionally licking of the pelage. Stretching and yawning have also been observed. Licking of the everted rectum and coprophagy are common behaviours (Baxter & Meester 1982).

Mating behaviour includes 'flehmen' when the ♂ sniffs the ano-genital region of the female (Baxter 1981), and chases last for up to 35 minutes. During the chasing, the ♀ occasionally pauses and the ♂ attempts to mount. Eventually the ♂ bites the rump of the ♀ and she stops. Successful intromission lasts for seven seconds with the male biting strongly on her mid-back. After ejaculation, this grip is released and the ♀ moves off, dragging the male by his penis for a short period. After disengagement, the ♀ is usually aggressive towards the ♂ (Baxter & Meester 1982). Nests are spherical or saucer-shaped, often placed in rock crevices or under cover. Lactating ♀♀ show no aggression to strange young and will foster them (Baxter 1993a).

Reproduction and Population Structure Pregnancies occur during late dry season and wet season (Aug–Apr), but mostly in Oct–Dec. Gestation: ca. 28 days. Mean litter-size: 3.65 (n = 51), commonly 4. At birth: HB: 36.3 mm, T: 11.1 mm, HF: 6.2 mm, E: 2.5 mm, weight 1.8 g (n = 186). Young born naked, blind and helpless but development is rapid. Weaning at Day 18–22; by Day 28 young are adult size in all measurements except weight. Walking begins ca. Day 5, when caravanning first observed. Eyes and ears open ca. Day 12. Full pelage present ca. Day 14. Caravanning ceases ca. Day 16. Young leave nest ca. Day 28 (R. M. Baxter unpubl.). Young displaced from nest emit a high-pitched squeak after which they are retrieved by the female and carried in her mouth back to the nest. Females have a postpartum oestrus and litters can be conceived consecutively. Maturity usually attained by Day 90, but might occur as early as Day 28. Longevity 14–18 months in the wild but can be 2.5 years in captivity (R. M. Baxter unpubl.).

Predators, Parasites and Diseases Known predators include Banded Mongooses *Mungos mungo* (Baxter 1993b), Water Mongooses *Atilax paludinosus*, Zorillas *Ictonyx striatus*, Striped Weasels *Poecilogale albinucha* and two species of owl. Domestic cats capture but seldom consume these shrews (Baxter 1977).

Conservation IUCN Category: Least Concern.

A common shrew in urban gardens over much of its range.

Measurements

Crocidura flavescens
HB (♂♂): 99.3 (81–112) mm, n = 70
HB (♀♀): 100.3 (83–117) mm, n = 50
T (♂♂): 48.8 (41–59) mm, n = 69
T (♀♀): 48.6 (36–58) mm, n = 50
HF (♂♂): 14.8 (13–16) mm, n = 70
HF (♀♀): 14.8 (13–16) mm, n = 50
E (♂♂): 10.3 (9–11) mm, n = 70
E (♀♀): 10.2 (9–11) mm, n = 50
WT (♂♂): 30 (20–40) g, n = 10
WT (♀♀): 25.2 (20–38) g, n = 17
CI (♂♂): 26.6 (24.7–28.6) mm, n = 64
CI (♀♀): 26.2 (24.5–28.3) mm, n = 49
GWS (♂♂): 10.8 (10.2–11.4) mm, n = 56
GWS (♀♀): 10.7 (10.0–11.4) mm, n = 43
I^1–M^3 (♂♂): 11.9 (10.9–12.7) mm, n = 85
I^1–M^3 (♀♀): 11.7 (10.7–12.7) mm, n = 62
Measurements: South Africa (Meester 1963, Taylor 1998 [weight]).

Key References Baxter 1977; Baxter & Irwin 1995; Baxter & Meester 1982; Baxter *et al.* 1979.

R. M. Baxter & N. J. Dippenaar

Crocidura floweri Flower's Shrew

Fr. Crocidure de Flower; Ger. Flowers Spitzmaus

Crocidura floweri Dollman, 1915. Ann. Mag. Nat. Hist. ser. 8, 15: 515; 1916 Ann. Mag. Nat. Hist., ser. 8, 17: 192. Giza, Egypt.

Taxonomy Hutterer & Harrison (1988) suggested that this species may be related to *C. arabica* (a non-African species) and *C. crossei*. Synonyms: none. Chromosome number: not known.

Description Small shrew. Dorsal pelage pale cinnamon-brown. Ventral pelage paler to whitish; hairs grey at base, white at tip. Abrupt delineation laterally of dorsal and ventral colours. Feet dirty white. Tail relatively long to very long (75–100% of HB), cinnamon-brown above, whitish below; bristle hairs bicoloured; pilosity 50%. Skull: second and third unicuspids subequal; third upper molar moderately broad; talonid basin present on third lower molar. Molars with a metaloph and metaconule (Heim de Balsac & Mein 1971). Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Sahara Arid BZ. Recorded from Nile Delta and El Faiyum (Osborn & Helmy 1980), and Wadi el Natrun, Egypt (Goodman 1989). Unconfirmed record in S Sudan (Wolsan & Hutterer 1998). Also identified in ancient mummified remains at Thebes in S Egypt (Heim de Balsac & Mein 1971).

Habitat Unknown except that specimens have been collected in fields.

Abundance No information.

Remarks Little information available. One specimen was obtained from the stomach of a cattle egret (Flower 1932, in Osborn & Helmy 1980) and another from regurgitated pellets of a Little Owl *Athene noctua* at Wadi el Natron.

Conservation IUCN Category: Data Deficient.

Major threats are human-induced habitat loss and degradation, and restricted distribution.

Crocidura floweri

Measurements

Crocidura floweri

HB: 57–71 mm*
T: 55–58 mm*
HF: 12–13.5 mm*
E: 8 mm*
WT: n. d.
CI: 18.4 (18.0–19.2) mm, n = 4
GWS: 7.8 (7.6–8.2) mm, n = 4
I^1–M^3: 7.5 (7.3–7.7) mm, n = 4
Giza, Egypt (BMNH, Osborn & Helmy 1980)
*Flower 1932 (no means or sample sizes recorded)

Key Reference Osborn & Helmy 1980.

P. D. Jenkins & S. Churchfield

Crocidura foxi Fox's Shrew

Fr. Crocidure de Fox; Ger. Foxs Moschusspitzmaus

Crocidura foxi Dollman, 1915. Ann. Mag. Nat. Hist., ser. 8., 15: 514. Panyam, Nigeria.

Taxonomy Considered as a member of the *poensis* group, and probably closely related to *C. theresae* (see Hutterer & Happold 1983, Hutterer 2005b). A series from Owerri, S Nigeria, referred to *C. foxi* by Hutterer & Happold (1983) now considered to represent a dark form of *C. lamottei*. Synonyms: *tephra*. Subspecies: none. Chromosome number: not known.

Description Large to very large shrew. Dorsal pelage chocolate-brown to russet-brown; hairs grey at base with brown tip. Ventral pelage grey; hairs grey, sometimes white at tip. Colour of ventral pelage well delineated from colour of dorsal pelage. Flanks, chest and throat grey. Tail relatively short (50–63% of HB), pale, coarsely haired; pilosity ca. 20–35%. Skull: braincase flat (more so than in

C. poensis and *C. nigeriae*). First upper incisor long and hooked. First unicuspid larger than second or third unicuspids. Third molar small. Nipples: not known.

Geographic Variation Specimens from Senegal are darker than those from elsewhere.

Distribution Endemic to Africa. Sudan Savanna BZ. Recorded from Jos Plateau, Nigeria (type series), and from Senegal to S Sudan (Hutterer 2005b).

Habitat In Nigeria, found in long grass, secondary bush, near to farmlands, and in rocky grasslands recently burned (Hutterer & Happold 1983). In Senegal, found in cultivated irrigated areas between series of dunes, and in swampy zones with grasses; coexists with *Dasymys rufulus* and *Mastomys huberti* (Niayes region, north of Dakar; J.-M. Duplantier unpubl.).

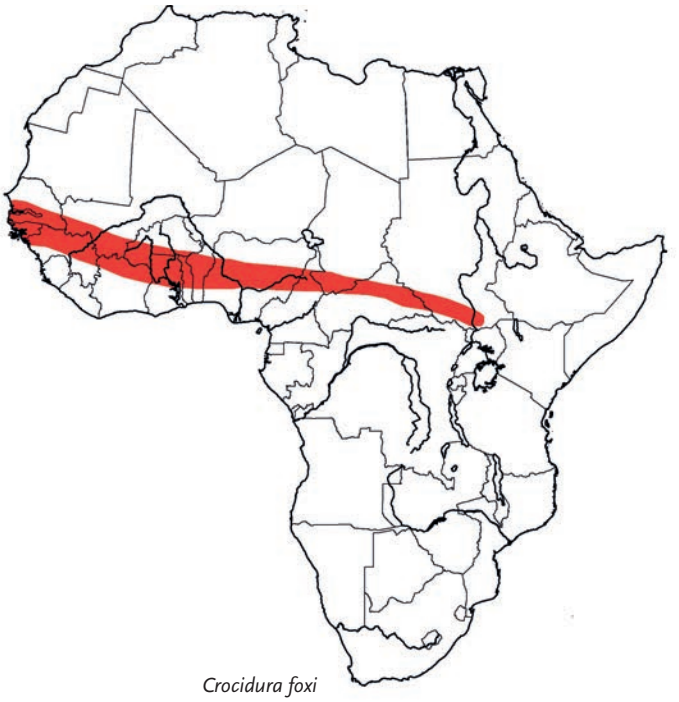
Abundance Locally abundant in Nigeria (Hutterer & Happold 1983).

Remarks Embryo number: 2 (n = 1: Nigeria; Happold 1987). Embryo number: 3.25 (range 2–4, n = 4; Senegal; J.-M. Duplantier unpubl.).

Predators, Parasites and Diseases Found in pellets of Barn Owls *Tyto alba* in Senegal (J.-M. Duplantier unpubl.).

Conservation IUCN Category: Least Concern.

Measurements
Crocidura foxi
HB: 103.5 (91–114) mm, n = 30
T: 60.7 (53–72) mm, n = 27



Crocidura foxi

HF: 16.9 (15.5–18.5) mm, n = 30
E: 10.0 (8–11) mm, n = 30
WT: 16.8 (13–22) g, n = 30
CI: 24.5 (23.5–25.8) mm, n = 25
GWS: 10.5 (8.8–11.2) mm, n = 24
I^1–M^3: 10.6 (9.9–11.3) mm, n = 25
Niayes, Senegal (J.-M. Duplantier & L. Granjon unpubl., MNHN)

Key References Hutterer 2005b; Hutterer & Happold 1983.

J.-M. Duplantier & L. Granjon

Crocidura fulvastra Savanna Shrew

Fr. Crocidure de savane; Ger. Savannen-Spitzmaus

Crocidura fulvastra (Sundevall, 1843). K. Svenska Vetensk-Akad. Handl. Stockholm, 1842: 172 (publ. 1843). Bahr el Abiad, Sudan.

Taxonomy Originally described as *Sorex fulvaster*. Synonyms: *arethusa*, *beta*, *diana*, *fulvaster*, *macrodon*, *marrensis*, *sericeus*, *strauchii* (see Hutterer 1983c, 2005b, Hutterer & Happold 1983, Hutterer & Kock 1983). Subspecies: none. Chromosome number: not known.

Description Very large shrew. Dorsal pelage pale brown to cinnamon; hairs bluish-grey tipped with cinnamon. Ventral pelage and flanks whitish-grey clearly delineated from dorsal pelage; hairs grey with white tips. Tail of medium relative length (ca. 60% of HB), thin, brownish; pilosity 80–85%. Skull long and narrow in general shape, with long rostrum, narrow interorbital constriction. Braincase oval. Zygomatic process of maxilla angular. First upper incisor long and sharp, passing straight downwards. Upper premolars and molars narrow compared with *C. viaria*, *C. lamottei* and *C. butleri*. Shows considerable sexual dimorphism (Hutterer & Happold 1983). Nipples: not known.

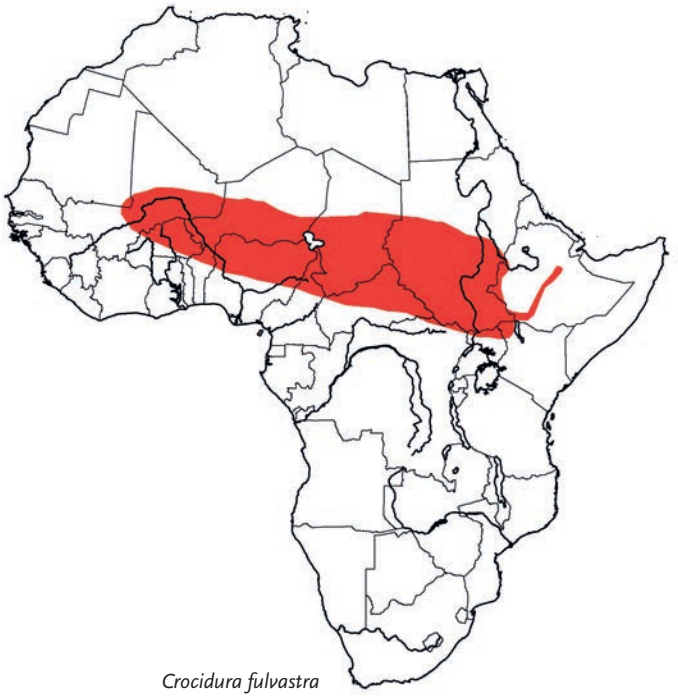
Geographic Variation None recorded.

Distribution Endemic to Africa. Sudan and Sahel Savanna BZs as well as parts of Guinea Savanna BZ in Sudan, and the Rift Valley of Ethiopia. Locality records very disjunct. Recorded from Mali, N Nigeria, S and C Sudan, Ethiopia and N Kenya. May occur in Mauritania and Senegal. One mummified specimen recorded from ancient Egypt (Hutterer 1983c).

Habitat Drier savanna habitats but likely also to inhabit a variety of mesic habitats.

Abundance Occurs quite frequently in savanna habitats in Nigeria (Hutterer & Happold 1983).

Remarks Comprised 0.3% of all shrews found in pellets of the



Crocidura fulvastra

Spotted Eagle-owl *Bubo africanus* in Awash N. P., Ethiopia (Demeter 1982). Remains have also been found in owl pellets in Nigeria (Hutterer & Jenkins 1980, Demeter 1981). Other likely predators include small carnivores such as mongooses, genets and small cats known to feed on shrews.

Conservation IUCN Category: Least Concern.

Not uncommon and hence of no immediate conservation concern.

Measurements

Crocidura fulvastra

HB (♂♂): 99–120 mm, n = 4
HB (♀♀): 86–94 mm, n = 5
T (♂♂): 57–64 mm, n = 4
T (♀♀): 49–55 mm, n = 5
HF (♂♂): 14–17 mm, n = 4
HF (♀♀): 14–15 mm, n = 5
E (♂♂): 12–13 mm, n = 4
E (♀♀): 10–11 mm, n = 5
WT (♂♂): 16–29 g, n = 4
WT (♀♀): 10–18 g, n = 5
CI (♂♂): 23.6–25.7 mm, n = 4
CI (♀♀): 21.1–22.7 mm, n = 5
GWS (♂♂): 10.0–10.6 mm, n = 4
GWS (♀♀): 9.1–9.7 mm, n = 5
I^1–M^3 (♂♂): 10.0–10.8 mm, n = 4
I^1–M^3 (♀♀): 8.9–10.0 mm, n = 5
Nigeria (Hutterer & Happold 1983; mean values not recorded)

Key References Hutterer 2005b; Hutterer & Happold 1983; Hutterer & Jenkins 1980.

S. Churchfield & P. D. Jenkins

Crocidura fumosa Smoky Mountain Shrew (Smoky White-toothed Shrew)

Fr. Crocidure du Mont Kenya; Ger. Smoky Mountain Spitzmaus

Crocidura fumosa Thomas, 1904. Ann. Mag. Nat. Hist., ser. 7, 14: 238. Western slope of Mt Kenya. 2600 m.

Taxonomy Revised by Dippenaar & Meester (1989). Similar to *C. montis*. Synonyms: *alchemillae*. Subspecies: none. Chromosome number: not known.

Description Medium-sized shrew. Dorsal pelage dark grey-brown, slightly paler ventrally. Feet pale greyish- to yellowish-brown. Tail medium-long (50–80% of HB), greyish to reddish-brown above, paler below; pilosity 50–90%. Skull with wide interorbital region and broad high-domed braincase. Third unicuspid usually larger than second. Third upper molar moderately broad; talonid of lower third molar with entoconid and talonid basin. Nipples: not known.

Geographic Variation None recorded.

Distribution Endemic to Africa. Afromontane–Afroalpine BZ. The revision by Dippenaar & Meester (1989) restricts this species to the Aberdare Range and Mt Kenya, Kenya. Also recorded from the Cherangani Hills, Kenya. Previously reported to occur widely in Kenya, Tanzania and Uganda.

Habitat Montane forest. A specimen from Mt Kenya was obtained

Crocidura fumosa